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NWS FCST 31

A 20-YEAR SUMMARY OF NATIONAL WEATHER SERVICE VERIFICATION RESULTS FOR TEMPERATURE AND PRECIPITATION

National Weather Service
Silver Spring, Md.
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A 20-YEAR SUMMARY OF NATIONAL WEATHER SERVICE VERIFICATION RESULTS FOR TEMPERATURE AND PRECIPITATION

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ABSTRACT

Trends in the accuracy and skill of National Weather Service forecasts of temperature and precipitation have been analyzed based on a new, 20-year verification archive which is more consistent and homogeneous than data sets which were used in the past. In particular, a subset of verification sites was selected for which data were available throughout most of the period of record. Also, a consistent set of maximum/minimum temperature observations was used to verify the temperature forecasts. Based on this new data set, nationwide average scores were computed both for the locally issued official forecasts and the centrally produced guidance. The verification measures include percent improvement over climate for probability of precipitation forecasts, and mean absolute error and percent of errors >10°F for maximum and minimum temperature forecasts. The results were stratified by forecast projection and season.

There is strong evidence that the local and guidance forecasts for both weather elements have improved over the 20-year period from 1966-1986. For example, the overall skill scores for probability of precipitation forecasts during both the warm and cool seasons for all three forecast periods (12-24, 24-36, and 36-48 h projections) show improving trends at or above the 99% level of significance. Similar trends of improving accuracy are evident in the error statistics associated with local and guidance forecasts of temperature for both seasons and for all three forecast periods. In contrast, for most stratifications, our analysis indicates that the accuracy of the longer range (48-60 h) local and guidance temperature forecasts has not improved in a statistically significant manner. However, the lack of a significant trend may be due to the limited length of the time series available for the analysis of the longer range temperature forecasts (1975-1986).

1. INTRODUCTION

An extensive set of National Weather Service (NWS) temperature and precipitation forecasts has been collected and verified on a national basis since April 1966. Although the guidelines for the so-called Public Verification Program have changed over the years, most of the forecast procedures, verification measures, and verification sites have remained relatively stable. The Appendix contains a brief history of the program. Certainly, there has been enough consistency to establish nationwide, long-term trends in regard to skill and accuracy.

Several verification studies have been conducted by the NWS during recent years. Results are documented by the NWS/FCST series of NOAA Technical Memoranda (e.g., Polger, 1983; Cooley et al., 1981) and by various Techniques Development Laboratory (TDL) Office Notes (e.g., Carter et al., 1985a and 1985b). In addition, others such as Glahn (1984 and 1985), Murphy and Sabin (1986), and Ramage (1982) have analyzed long-term trends in the verification scores given in the published reports. In most cases, statistically significant trends of improving accuracy and/or skill have been noted. However, the detailed findings of these studies have varied depending on factors such as weather element, verification measure, length of record, seasonal stratification, and number of forecast sites.

Recently, a machine-readable national archive of NWS precipitation and temperature forecasts and matching observations was compiled for the period from April 1966 to March 1986. Both centrally produced guidance and locally issued "official" forecasts for the 0000 and 1200 GMT forecast cycles were included for about 100 stations throughout the conterminous United States.[1] In addition, a complete set of maximum and minimum surface temperature observations valid for approximately 12-h periods was compiled for use in verifying the local and guidance forecasts. In past studies (e.g., Murphy and Sabin, 1986), the verifying temperature observations were comprised of a mixture of reports valid for either 12-h or calendar day periods. Hence, in this new data base, both the verification sites and the valid periods for the verifying temperature observations are more homogeneous than those used in the past.[2]

The purpose of this report is to identify nationwide trends in the quality of NWS temperature and precipitation forecasts, and also to document the new, long-term verification archive. We hope this analysis will help to remove some ambiguity associated with previous results based on the older, less uniform data sets.

2. VERIFICATION MEASURES

Depending on which characteristics of the forecasts are of main concern to the users (or to the evaluators), several different types of scores can be calculated in order to assess the quality of temperature and precipitation forecasts. For this report, we chose to present traditional, widely accepted verification measures. The results, obtained from a matched sample of local FP and guidance forecasts, were stratified by forecast projection and season. The warm season is defined as April through September, while the cool season extends from October through March.

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[1] As pointed out by Glahn (1985) and discussed in the Appendix, three sets of forecast data were collected up to and including April 1971--local, Public Forecast (FP), and National Meteorological Center (NMC) guidance. For purposes of consistency, only the FP's and the NMC guidance are in the new, long-term verification data archive. In this document, we usually refer to the FP's as local FP forecasts and the NMC guidance as guidance.

[2] The format of the archive is the same as that used for the new verification data processing system (Dagostaro, 1985). Further details regarding the format and the locations for which data are available are provided in the Appendix.

A. Precipitation

As documented in the Appendix, the archived precipitation forecasts are expressed as probabilities of measurable precipitation ($\geq$.01 inch). Traditionally, the accuracy of probability of precipitation (PoP) forecasts has been measured by the Brier score (Brier, 1950). We calculated the standard NWS Brier score for PoP which is one-half the original score defined by Brier. Of course, Brier scores vary from one station to the next and from one year to the next due to changes in the relative frequency of precipitation. Therefore, we also computed a measure of skill, the percent improvement over climate, that is, the percent improvement of the Brier score obtained from the local FP's or the guidance over the analogous Brier score produced by climatic forecasts. Climatic forecasts are defined as monthly relative frequencies of precipitation by station as determined from a 15-year sample (Jorgensen, 1967).

Similar to the analyses conducted by Glahn (1984 and 1985), we combined the results from both forecast cycles (0000 and 1200 GMT) before the long-term trends were identified. In contrast to Glahn's study, PoP forecasts were available for both forecast cycles during the first warm and cool seasons, 1966 and 1966-67, respectively. However, data from the warm seasons of 1966, 1967, and 1968, and the cool seasons of 1966-67, 1967-68, and 1968-69, were not included in the analysis of the first-period (12-24 h) PoP guidance because these forecasts had been recorded as categorical (0 or 100%) statements only. In addition, although this was not a major focus of our study, we analyzed the long-term trends in the forecasts for each cycle separately.

B. Temperature

Analogous to Murphy and Sabin (1986), the accuracy of maximum/minimum temperature forecasts was determined by calculation of the mean absolute error statistic. In addition, since large errors are of concern to users, we computed the percentage of errors >10°F. Of course, these statistics are influenced by the variability of the observed temperature from year to year. Similar to the PoP verifications, data from both forecast cycles were combined by projection for the determination of long-term trends. The trends in the accuracy of maximum or minimum temperature forecasts considered separately also were examined.

3. VERIFICATION RESULTS

Applying the verification measures discussed in Section 2, we have identified the long-term trends in skill and/or accuracy for both the local FP and the guidance forecasts of precipitation and temperature over the 20-year period from April 1966 to March 1986. In particular, a simple linear regression model was fit to each time series. This is the same approach as that used by Glahn (1984 and 1985) and Murphy and Sabin (1986). Under the assumption that the differences between the actual scores and the scores estimated by the regression model are independent and normally distributed, it is possible to determine the statistical significance of the slope of the regression line. Hence, probability levels (p-values) were determined from the computed F-statistic associated with each of the regression equations. A p-value represents the probability obtained from a test of the null hypothesis that the regression coefficient (i.e., the slope) is equal to zero. For example, a p-value of .05 is interpreted as meaning that an F as large as or larger than that computed would occur by chance only 5% of the time under the null hypothesis of a zero coefficient. The statistical package (SAS Institute, 1979) used in this study gave

p-values as small as .0001. In this analysis, we considered the trends to be statistically significant when the p-values were less than .05. In addition, confidence limits were determined for the slope of the regression. Hence, at a prescribed confidence level (95% in our study), the true value of the slope may be considered to lie within the interval bounded by the confidence limits.

For any particular season, the trends in the skill and/or accuracy represent nationwide averages for about 80 of the 100 stations identified in the Appendix. Of course, the long-term trends for particular forecast sites, or for geographic areas which are dominated by highly variable weather regimes, may be considerably different than those shown for the national averages. Note that the PoP forecasts usually exhibit greater skill during the cool season than in the warm season when convective precipitation events occur more frequently. Moreover, the overall accuracy of the temperature forecasts generally is better during the warm season when observed temperatures fluctuate less from day-to-day. Finally, the skill and accuracy of both the PoP and temperature forecasts usually decrease as forecast lead times increase.

A. Precipitation

As we mentioned in Section 2, the results for both forecast cycles were combined before the primary analyses of long-term trends were conducted. In addition, the trends in the forecasts for each cycle were examined. In each case, the measure of skill was the percent improvement over climate of the NWS Brier score.

Warm Season

Time series of skill scores for the first (12-24 h), second (24-36 h), and third (36-48 h) forecast periods are shown in Figs. 1 and 2 for the local FP forecasts and the corresponding PoP guidance, respectively. Table 1 displays the analogous improvement over climate scores for each cycle separately. Table 2 shows the corresponding slope, p-value, and 95% confidence interval of the slope for each stratification. As indicated by Table 2, the trends for both the local and guidance forecasts and for all stratifications are substantial (slopes $\geq$.399%/year with lower confidence limits $\geq$.243%/year) and highly significant (p-values = .0001). In general, the trends of improving skill are considerably stronger (i.e., the slopes of regression lines are greater) for the guidance than for the local FP forecasts for the first period but slightly weaker for the third period. This is because the skill of the first-period guidance was relatively low compared to the skill of the FP forecasts during the initial years of the verification record. Overall, the local FP forecasts usually are more skillful than the corresponding guidance. However, the magnitude of the difference in the skill scores decreases considerably as the forecast projection increases.

Cool Season

The skill scores and regression lines for the cool season FP and guidance PoP forecasts are shown in Figs. 3 and 4, respectively. The results for each cycle are given in Table 3, while Table 4 shows results from the various analyses of significance of the long-term trends. Similar to the warm season results, all trends are substantial (slopes $\geq$.440%/year with lower confidence limits $\geq$.285%/year) and highly significant. However, for the cool season the trends

in skill are stronger for the second- and third-period local FP and guidance forecasts. In addition, the local FP forecasts (especially those for the first period) were usually more skillful than the corresponding PoP guidance. In comparison to the results for the warm season, the cool season skill scores were about 5 to 10% higher.

B. Temperature

Verification scores for both maximum and minimum temperature and for both forecast cycles were combined in order to carry out the primary analyses of the long-term trends in accuracy of the FP and guidance temperature forecasts. Secondary analyses of trends in the individual maximum or minimum temperature forecasts for each cycle also were conducted. The two measures of accuracy were mean absolute error and percentage of errors >10°F.

The guidance forecasts were valid for calendar day periods throughout most of the period of record as we've noted in the Appendix. In contrast, the verifying observations were valid for approximately 12-h periods. Of course, this affected the verification scores for the guidance. However, the long-term trends should not be impacted in any significant manner.

Warm Season

Figs. 5 and 6 show the 20-year trends in accuracy for the warm season as measured by the mean absolute error of the local FP forecasts and the guidance, respectively. Results are given for four lead times of approximately 12-24, 24-36, 36-48, and 48-60 hours. As documented in the Appendix, fourth-period forecasts were not available until October 1975. Table 5 displays the analogous scores for each cycle separately, while Table 6 provides the slope, p-value, and 95% confidence interval of the slope for each stratification. These analyses reveal long-term trends of increasing accuracy (i.e., all slopes are negative) which are statistically significant (p-values $\leq$.0226) for both the local and guidance forecasts and for all stratifications, except for the 48-60 h forecasts from 0000 GMT and the 48-60 h forecasts for both cycles combined. Again, the slopes usually are greater (more negative) for the guidance which was much less accurate than the local FP forecasts during the initial years. Except for the first 3 years of record, the superiority of the FP forecasts over the corresponding temperature guidance diminishes as the forecast lead time increases.

Time series of the percentage of errors >10°F are shown in Figs. 7 and 8. Table 7 shows the FP and guidance scores for each cycle separately, while Table 8 presents the slope, p-value, and 95% confidence limit associated with each stratification. Once again, the analyses reveal statistically significant trends of improving accuracy (p-values $\leq$.0242) for both types of forecasts and for all projections except for the majority of those for 48-60 hours.

Cool Season

Time series of mean absolute errors and the corresponding regression lines for the cool season FP and guidance temperature forecasts are shown in Figs. 9 and 10, respectively. Table 9 provides mean absolute errors associated with the maximum and minimum temperature forecasts for each cycle separately, while Table 10 shows results from the various analyses of significance of the long-

term trends. Again all slopes are negative and highly significant (p-values $\leq$.0265) except for most of those for 48-60 hours. For both the local FP and guidance forecasts, the cool season trends of improving accuracy are usually stronger than are the corresponding warm season trends.

The cool season time series of the percentage of errors >10°F for the FP and guidance temperature forecasts are given in Figs. 11 and 12, respectively. Table 11 shows the statistics for each cycle separately, while Table 12 presents the analysis of significance results. All slopes are negative and significant (p-values $\leq$.0264) except those associated with the majority of the 48-60 h projections. Also, the trends of improving skill usually are stronger (more negative) for the guidance than for the local FP forecasts.

4. SUMMARY AND CONCLUSIONS

Trends in the skill and/or accuracy of NWS precipitation probability and temperature forecasts have been determined at the national level for about 80 verification sites during the period from April 1966 to March 1986. The primary focus of our study dealt with determination of trends in the data combined from both forecast cycles (0000 and 1200 GMT) and stratified according to forecast type, season, lead time (projection), and verification measure. For completeness, we also conducted secondary analyses of the data stratified according to forecast cycle. Both the primary and secondary analyses indicate that statistically significant trends of improving skill or accuracy are associated with both the local FP and central guidance predictions. This is evident in the overall results for most combinations of forecast type, season, forecast cycle, and lead time. The only notable exception is in regard to the accuracy of some of the 48-60 h maximum/minimum temperature forecasts. However, the lack of a significant trend in these data may be due, in part, to the limited length of the time series available for analysis (October 1975-March 1986).

In summary, the major conclusions are:

1) The national skill scores for both the local FP and guidance PoP forecasts for all combinations of seasons, forecast cycles, and lead times show improving trends which range from .4 to .9%/year. Furthermore, these trends are statistically significant above the 99% level of significance.

2) The national scores for both mean absolute error and percentage of errors >10°F for the local FP and guidance temperature forecasts for all projections out to 48 hours show improving trends for all combinations of seasons and forecast cycles. For mean absolute error, the average trends range from about -.01 to -.09°F/year, while those for the percentage of errors >10°F range from -.04 to -.57%/year. These trends are significant above the 97% level.

For precipitation probability, our findings extend and confirm those of Glahn (1984 and 1985). The results for both precipitation and temperature also are similar to those of Murphy and Sabin (1986), except our time series for the temperature forecasts show much less fluctuation from year-to-year. This is most likely because, as mentioned in Section 1, the new data archive is more homogeneous in regard to verification sites and the valid periods of the verifying temperature observations. We expect that in the future investigators also will make use of the new verification archive to compute different scores associated with other stratifications in order to identify long-term trends in many other attributes of the forecasts.

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APPENDIX

The NWS Public Weather Verification Data Archive

The National Weather Service has established an "official" long-term record of forecast and observed data for 100 locations located throughout the conterminous United States. The offices in Alaska, Hawaii, and Puerto Rico administer independent verification programs and are not part of the data archive. This permanent, machine-readable archive includes the weather elements of temperature and precipitation from the Public Verification Program. Verification of forecasts has always been part of the NWS effort; however, there has not always been a consistent long-term analysis. An ideal set of forecasts and observations would be obtained from a uniform office network and would be produced by similar procedures throughout the entire period of the record. The data available from the National Verification Program which began in 1966 best meets these requirements. In order to properly analyze these data, the user should be aware of the origin of the program and changes that have taken place since its inception. This document presents a historical perspective of the forecast procedures and provides an account of the pertinent changes in the verification program.

In the late 1960's, there was a general reorganization of the then Weather Bureau forecast structure which evolved into the present system. Prior to that time, a three-echelon forecast system had existed in which the first level, the National Meteorological Center (NMC), concerned itself with the analysis, prediction, and interpolation of large-scale atmospheric motions. A second echelon used the guidance produced by the first as a tool to compare with its weather watch and the independent analysis and prediction of both large-scale and small-scale weather features. The third level issued more specialized forecasts and information than were provided by the second.

The changes to the forecast structure which were instituted in the late 1960's were related to advances made at the NMC over a period of years. In particular, the quality of prognostic charts (both surface and upper air) improved dramatically. There was also a concurrent increase in the successful interpretation of these charts by NMC forecasters in terms of cloudiness, winter storms, quantitative precipitation, and other meteorological phenomena. In addition, successful specialization led to increased reliance upon the National Hurricane Center (NHC) and the National Severe Storm Forecast Center (NSSFC) for forecasts of hurricanes and severe storms.

The new forecast structure was also comprised of three echelons. This system was more dependent than the previous one upon a flow of forecast information directly from the first echelon, consisting of the NMC, NHC, and NSSFC, to a second echelon consisting of area forecast centers. The area forecast centers were responsible for state forecasts which were included in the "official" Public Forecast (FP). This product included temperature and precipitation forecasts for each office in the FP area. The third echelon in the system was the zone and local forecast offices which adapted and modified the FP guidance.

FP/NMC Verification Program

A verification system was designed to include concurrent verification of guidance material on which the public forecasts were based. One segment of this effort was the FP/NMC Forecast Verification Program initiated in 1966. All the FP offices participated in this program. Forecast, guidance, and observed data were entered daily on an FP/NMC verification form by the FP center for itself and for a group of stations in that FP area. The stations were selected on the basis of representativeness for the area covered by the forecast. A verification station could be either first- or second-order, synoptic or airway, as long as it was reasonably dependable and representative. While the forecasts entered on the verification form were intended to reflect the FP, or State Forecast as released to the public, the forecaster was given some latitude in determining what entry would be shown for each verification station. The numerical models which provided guidance were based on 0000 and 1200 GMT cycle data. An appropriate maximum or minimum temperature and probability of precipitation were entered for each forecast period for each station. The possible entries for PoP were 0, 2, 5, 10, 20, 30, 40, 50, 60, 70, 80, 90, and 100 percent. The approximate release times of the FP forecasts for the two forecast cycles for which verification data were collected were 1000 and 2200 GMT. The periods covered by the forecasts were:

CYCLE (GMT)	FORECAST PERIODS (GMT)		
0000	1200-0000 Today	0000-1200 Tonight	1200-0000 Tomorrow
1200	0000-1200 Tonight	1200-0000 Tomorrow	0000-1200 Tomorrow Night

The release times and forecast periods have remained virtually unchanged since the inception of the FP/NMC verification program. The guidelines for the present verification system are given in National Weather Service (1983). The data collection began in April 1966 and continues to the present. Details on data collection, guidance forecasts, observations, office selection, and data availability are provided in subsequent sections of this document.

Data Collection

The procedure for recording and collecting the forecasts and observations of the maximum/minimum temperature forecasts and PoP forecasts has been revised several times since 1966. A summary of significant events is presented in Fig. 13. Initially, the data were entered daily on a verification form and later transferred to punch cards. The punch cards were sent to Weather Service Headquarters (WSH). The card punching was centralized at WSH in May 1971, and new forms were introduced for entering the data required for verification. The forecasts were entered on a single form and included the FP maximum/minimum temperature forecasts and the FP and NMC PoP forecasts. The NMC temperature guidance was collected automatically by the central computer system.

A separate form was used for the observations corresponding to the NMC guidance and FP forecasts. The entries of maximum/minimum temperatures and precipitation amounts for the 12-h periods made on this form represented observational data used only for the computation of the official National Weather Service verification scores.

The system remained relatively constant until March 1974 when mark sense cards, which were already in use for the aviation verification program, replaced the public verification forms. The mark sense cards allowed data entered on the card to be read directly by machine, thus eliminating the need for card punching. Only the FP forecasts and observations were entered on the cards.

Effective July 1975, all offices discontinued the preparation of mark sense cards for the public verification program. The FP temperature and PoP forecasts were collected automatically by the central computers from the Coded City Forecast (FPUS4) bulletins. Corresponding observations were collected from the Selected Cities Summary tapes prepared by the National Climatic Data Center. A fourth forecast period was added to the data archive for temperature only beginning in October 1975.

The next major change in the data collection system occurred with the introduction of the Automation of Field Operations and Services (AFOS) system and the AFOS-era verification (AEV) program (Ruth, et al. 1985). The AEV program became operational in October 1983. The AEV creates a standardized data base at each station which includes the local forecasts and guidance along with the verifying observations. The data are transmitted via AFOS to the central computer and placed in the national archive. The archive discussed in this document contains both data from the pre-AFOS and AFOS-era periods, April 1966 through March 1986. The format of these data is documented in Fig. 14 and Table 13. A description of the National AFOS-era Verification Processing System is given in Dagostaro (1985).

The changes in the data collection methods since April 1966 were designed to increase efficiency and minimize the office workload. The evidence shows that each time a new system was introduced the error rate temporarily increased although careful editing was done to ensure data quality and to recover lost data. A change in the seasonal compilation procedure in 1970 resulted in no data being available for the month of April 1970. Also, a major computer change in January 1982 caused an extensive loss of FP forecasts until the AEV program began in October 1983. The data loss was most prevalent in the NWS Eastern Region.

Guidance Forecasts

Initially, the guidance for temperature and precipitation as provided to the FP centers was a forecaster prepared product based on information available at NMC. The guidance values entered on the verification forms were interpolated from facsimile charts which included temperature change forecasts and PoP forecasts covering four, 12-h synoptic periods. The transmission times of the guidance material available for the FP's released at 1000 and 2200 GMT were 0830-0900 and 2030-2100 GMT, respectively.

Objective (computer prepared) calendar day maximum/minimum temperature guidance became operational in April 1970. The initial objective forecasts of temperature for individual offices were based on the perfect prog method (Klein and Lewis, 1970). This was followed (August 1973) by the Model Output Statistics (MOS) forecasts (Glahn and Lowry, 1972) based on the Primitive Equation model (PE), and, concurrently, by MOS forecasts (April 1978) based on the Limited-area Fine Mesh model (LFM). The data archive contains the PE-derived

MOS forecasts through March 1980 when the PE-based system was replaced by the LFM guidance. The evolution of the MOS and perfect prog methods of forecasting maximum/minimum temperature is given by Klein and Dallavalle (1980). For PoP, the subjective NMC guidance was replaced by an objective system developed by the NWS Techniques Development Laboratory in January of 1972. This initial MOS system, which was subsequently extended and improved, is described by Lowry and Glahn (1976).

Observations

The observations used for verification correspond as closely as possible to the standard forecast periods and the location for which the forecast is valid. Occasionally, the areas for which the forecast is intended, such as a large city, and the observation site (usually an airport outside the city) are sufficiently different in a climatic sense (particularly for temperature) that verification scores can be biased. Los Angeles and San Francisco are examples of locations where this may be a problem.

The valid periods for the temperature observations have always been intended to conform to the standard definitions of "today" and "tonight." In most of the regions in the conterminous United States, the observed maximum (minimum) temperatures occur (or very nearly occur) in the 1200-0000 GMT (0000-1200 GMT) periods; an exception is the NWS Western Region where most minimum temperatures occur after 1200 GMT. To compensate for this difference, the period for minimum temperature for the Western Region was defined to be 0000-1800 GMT. In addition, forecast stations in extreme western sections of the Central and Southern Regions could also use this extended time period for the minimum temperature.

Beginning with the 1984-85 cool season, the AFOS-era verification system was modified to allow for collection of the proper daytime maxima and nighttime minima temperature observations for all verification sites (Ruth et. al., 1985). In addition, in November 1985 (National Weather Service, 1985) the MOS system was modified to provide temperature forecasts for daytime and nighttime periods instead of the calendar day periods which were used in the past.

For precipitation, there have been numerous schemes for stratifying the observed data in order to encode the record for the data archive. Table 14 shows the categories of observed precipitation used from April 1966 through September 1983. Note that from April 1966 through July 1968 the observed precipitation was categorized as either "0" for no measurable precipitation or ".99" to indicate precipitation $\geq$.01 inch. Prior to May 1971 a "trace" was not recorded, while the cutoff on the upper end was for precipitation >5.99 inches instead of >4.99 inches. Since October 1983 when the AFOS-era verification system was implemented, all precipitation amounts up to including 20 inches have been archived to the nearest .01 inches; the occurrence of a trace during the 12-h valid period is coded as .004.

Office Selection

The records of the offices retained in the data archive are representative of the FP/NMC network from April 1966 through the present. During this time period, the total number of offices in the network varied, as well as the offices which participated in the program. The 100 verification sites included in the data archive are shown in Fig. 15. In any given year, data usually are

available for about 80 of 100 sites. The names, call letters, and WBAN numbers of the 100 stations are given in Table 15. The primary factors for determining this group were whether the office was an FP center, length of record, and whether the office is in the present AEV network. Please note, as we mentioned earlier, data for all stations are missing for April 1970, and some of the stations do not have data throughout the entire period of record.

Data Availability

Data for all, or for a requested subset, of the forecasts and verifying observations in the new, 20-year verification archive will be provided to the research community in accordance with the fee guidelines established in NWS Operations Manual Letter 8-84 (or in accordance with subsequent updates). The current charge (including costs for the magnetic tape and mailing) is $160 per high-density (6250 bpi) tape copy. The forecasts and verifying observations for all stations for the entire period of record in the format specified by Fig. 14 comprise approximately 6 high-density tapes. Requests for data, or for further information, should be directed to:

National Weather Service, NOAA
Office of Meteorology, W/OM21
Program Requirements and Development Division
Silver Spring, MD 20910
(301) 427-7970

Table 1. Time series of national skill scores in terms of percent improvement over climate of the NWS Brier score for PoP forecasts during the warm season months of April through September.

Verification Period	Type of Forecast	Lead Time (h) 12-24 0000/1200 GMT	24-36 0000/1200 GMT	36-48 0000/1200 GMT
1966	Local FP	23.4/21.0	12.0/12.2	6.5/5.5
	Guidance	--/--	12.6/13.8	7.6/8.4
	No. Cases	14777/14784	14781/14782	14780/14783
1967	Local FP	24.6/22.5	14.1/13.6	9.3/8.2
	Guidance	--/--	12.9/13/5	7.8/8.8
	No. Cases	14791/14794	14796/14794	14794/14793
1968	Local FP	23.5/24.6	16.3/14.6	8.8/9.1
	Guidance	--/--	16.0/15.2	10.4/11.2
	No. Cases	14817/14817	14817/14817	14817/14817
1969	Local FP	25.3/24.4	14.4/15.7	9.7/8.6
	Guidance	14.6/15.3	13.0/13.6	8.8/8.9
	No. Cases	15365/15360	15366/15360	15361/15364
1970	Local FP	21.3/22.2	15.1/13.9	8.3/9.2
	Guidance	16.7/16.7	12.0/13.0	9.0/8.9
	No. Cases	12937/12907	12935/12912	12924/12911
1971	Local FP	23.6/23.9	14.3/13.2	7.9/8.9
	Guidance	17.1/19.1	12.6/11.8	7.5/8.5
	No. Cases	16732/16718	16725/16705	16724/16708
1972	Local FP	26.9/25.5	16.4/17.0	11.2/10.2
	Guidance	19.8/17.9	14.8/15.8	8.5/8.6
	No. Cases	17702/17197	17703/17189	17694/17190
1973	Local FP	28.5/28.4	18.1/17.9	9.9/10.9
	Guidance	21.8/21.5	16.5/17.6	10.0/10.6
	No. Cases	17344/17938	17347/17932	17340/17933
1974	Local FP	29.5/25.4	17.9/20.7	13.5/10.6
	Guidance	22.0/19.8	16.0/18.2	12.5/9.6
	No. Cases	14179/14631	14194/14603	14126/14587
1975	Local FP	24.0/21.6	15.9/13.8	10.3/9.0
	Guidance	18.0/14.3	11.3/12.4	9.3/8.6
	No. Cases	9250/9022	9303/8873	9155/8887
1976	Local FP	27.9/27.7	20.6/19.7	13.6/13.8
	Guidance	24.8/20.7	19.4/18.4	13.1/12.7
	No. Cases	12761/12577	12748/12425	12615/12426
1977	Local FP	26.4/25.3	19.0/17.8	11.9/13.2
	Guidance	23.4/23.8	15.4/14.5	9.6/10.5
	No. Cases	12181/12797	12113/12732	12043/12731

Table 1. (continued).

Verification Period	Type of Forecast	Lead Time (h) 12-24 0000/1200 GMT	24-36 0000/1200 GMT	36-48 0000/1200 GMT
	Local FP	30.6/30.0	22.6/23.1	17.5/16.9
1978	Guidance	28.4/27.6	19.9/21.5	15.5/15.0
	No. Cases	11533/11698	11503/11405	11091/11402
	Local FP	33.4/28.6	23.3/23.8	20.6/15.6
1979	Guidance	29.9/28.6	19.3/21.3	16.9/14.0
	No. Cases	9596/9519	9600/9214	9297/9217
	Local FP	28.5/26.4	19.9/21.2	15.8/14.6
1980	Guidance	26.7/24.7	22.3/21.7	16.3/15.0
	No. Cases	10523/9763	10526/9414	10092/9417
	Local FP	29.1/28.4	20.8/21.5	15.9/14.2
1981	Guidance	26.9/26.3	21.1/21.3	16.0/16.3
	No. Cases	11080/11311	11077/10966	10753/10958
	Local FP	27.3/26.0	20.3/20.9	16.4/16.6
1982	Guidance	24.6/25.3	21.4/21.2	17.0/18.0
	No. Cases	6069/5578	6067/5398	5899/5394
	Local FP	34.9/31.2	22.9/26.9	21.1/17.7
1983	Guidance	32.5/30.0	23.2/25.6	20.8/17.6
	No. Cases	7850/7451	7846/7270	7532/7264
	Local FP	30.8/29.5	23.7/22.3	18.2/17.4
1984	Guidance	28.2/27.6	23.3/22.1	18.4/17.3
	No. Cases	12604/12621	12670/12522	12565/12586
	Local FP	31.7/29.7	23.6/24.1	19.0/17.5
1985	Guidance	29.3/27.0	22.6/23.1	18.6/17.4
	No. Cases	13426/13384	13436/13361	13408/13365

Table 2. Trends in the skill of warm season PoP forecasts as indicated by the slopes (%/year) of regression lines fitted to the time series of percent improvement over climate skill scores, and the p-values and confidence intervals associated with those slopes.

Forecast Cycle	Lead Time (h)	Type of Forecast	P-value	Slope	95% Interval Lower	Upper
	12-24	Local FP	.0001	0.482	0.294	0.669
		Guidance	.0001	0.923	0.660	1.185
0000 GMT	24-36	Local FP	.0001	0.565	0.444	0.685
		Guidance	.0001	0.621	0.456	0.786
	36-48	Local FP	.0001	0.690	0.528	0.852
		Guidance	.0001	0.669	0.519	0.819
	12-24	Local FP	.0001	0.399	0.243	0.554
		Guidance	.0001	0.838	0.559	1.116
1200 GMT	24-36	Local FP	.0001	0.641	0.468	0.814
		Guidance	.0001	0.610	0.430	0.790
	36-48	Local FP	.0001	0.605	0.500	0.709
		Guidance	.0001	0.554	0.420	0.687
	12-24	Local FP	.0001	0.441	0.280	0.602
		Guidance	.0001	0.882	0.624	1.141
Combined	24-36	Local FP	.0001	0.599	0.464	0.734
		Guidance	.0001	0.613	0.447	0.780
	36-48	Local FP	.0001	0.647	0.526	0.768
		Guidance	.0001	0.611	0.478	0.744

Table 3. Same as Table 1 except for the cool season months of October through March.

Verification Period	Type of Forecast	Lead Time (h) 12-24 0000/1200 GMT	24-36 0000/1200 GMT	36-48 0000/1200 GMT
1966-67	Local FP	34.4/37.2	22.7/19.1	14.0/12.6
	Guidance	--/--	20.7/19.9	13.6/13.7
	No. Cases	14679/14682	14712/14710	14712/14712
1967-68	Local FP	38.0/38.2	23.9/22.5	14.8/14.2
	Guidance	--/--	22.5/22.4	15.4/14.5
	No. Cases	14783/14789	14790/14787	14784/14786
1968-69	Local FP	40.1/40.9	28.0/26.4	18.1/19.0
	Guidance	--/--	27.5/26.4	18.2/18.8
	No. Cases	14999/15001	15002/14997	15001/14994
1969-70	Local FP	37.1/38.1	23.6/22.4	15.3/11.9
	Guidance	30.6/31.9	22.2/20.7	14.7/14.6
	No. Cases	15379/15386	15380/15387	15380/15383
1970-71	Local FP	38.9/37.8	24.8/24.3	17.5/14.7
	Guidance	31.3/31.2	21.4/21.7	16.7/14.1
	No. Cases	15353/15346	15350/15345	15348/15347
1971-72	Local FP	37.1/35.8	22.4/23.4	16.3/14.5
	Guidance	30.9/30.0	22.3/22.5	16.6/15.7
	No. Cases	16655/16675	16257/16308	16239/16290
1972-73	Local FP	43.1/43.3	31.3/29.7	20.8/20.8
	Guidance	34.8/34.7	29.3/25.4	16.8/18.3
	No. Cases	13264/13490	13287/13474	13272/13484
1973-74	Local FP	41.1/37.4	26.5/28.8	19.2/17.4
	Guidance	33.9/31.3	25.7/26.4	19.3/15.6
	No. Cases	15910/16133	15942/16135	15930/16141
1974-75	Local FP	41.2/38.6	28.2/27.4	19.6/15.5
	Guidance	32.1/32.1	26.5/25.2	19.4/16.3
	No. Cases	10757/10447	10549/10367	10686/10242
1975-76	Local FP	41.2/38.2	29.8/30.4	22.5/20.9
	Guidance	32.0/29.4	26.4/23.5	20.3/18.3
	No. Cases	12808/11493	12825/11522	12751/11494
1976-77	Local FP	44.4/41.2	34.4/33.6	26.3/24.9
	Guidance	40.8/40.4	32.9/31.1	24.8/24.1
	No. Cases	13302/13465	13315/13331	13095/13327
1977-78	Local FP	42.9/41.9	32.8/31.9	26.2/23.8
	Guidance	39.4/38.5	30.9/29.0	23.1/21.5
	No. Cases	11586/12140	11665/12154	11672/12155

Table 3. (continued).

Verification Period	Type of Forecast	Lead Time (h) 12-24 0000/1200 GMT	24-36 0000/1200 GMT	36-48 0000/1200 GMT
1978-79	Local FP	44.8/42.0	33.8/34.9	29.3/27.5
	Guidance	43.6/40.7	29.9/31.3	24.3/23.6
	No. Cases	12210/12188	12224/11900	11915/11913
1979-80	Local FP	45.4/42.2	35.2/34.8	28.8/27.1
	Guidance	41.1/40.2	31.6/31.0	23.8/24.1
	No. Cases	9508/9480	9432/9061	9134/9059
1980-81	Local FP	44.9/42.8	33.6/33.9	28.3/24.1
	Guidance	42.0/42.8	35.0/33.6	27.4/24.6
	No. Cases	11065/10918	11054/10633	10624/10696
1981-82	Local FP	40.3/41.1	33.2/31.0	23.6/25.7
	Guidance	39.7/39.2	33.5/32.3	25.3/25.1
	No. Cases	8071/7820	8069/7584	7873/7583
1982-83	Local FP	46.6/44.8	34.9/35.0	28.3/26.9
	Guidance	44.3/42.4	33.6/35.0	26.9/26.5
	No. Cases	9473/8636	9477/8233	9000/8237
1983-84	Local FP	46.2/46.4	38.4/34.2	28.5/29.2
	Guidance	41.5/42.7	36.0/32.5	26.7/28.0
	No. Cases	10509/10420	10572/10317	10470/10367
1984-85	Local FP	46.0/45.2	36.6/33.8	26.6/27.5
	Guidance	40.9/41.2	35.5/31.4	25.3/25.5
	No. Cases	12985/12910	13002/12896	12967/12899
1985-86	Local FP	46.9/46.1	38.2/37.0	30.6/29.6
	Guidance	41.7/40.6	35.3/33.4	27.7/26.6
	No. Cases	13170/13080	13146/13085	13150/13071

Table 4. Same as Table 2 except for the cool season.

Forecast Cycle	Lead Time (h)	Type of Forecast	P-value	Slope	95% Interval Lower	Upper
	12-24	Local FP	.0001	0.539	0.389	0.689
		Guidance	.0001	0.836	0.557	1.115
0000 GMT	24-36	Local FP	.0001	0.819	0.645	0.992
		Guidance	.0001	0.811	0.635	0.987
	36-48	Local FP	.0001	0.862	0.675	1.048
		Guidance	.0001	0.754	0.630	0.879
	12-24	Local FP	.0001	0.440	0.285	0.595
		Guidance	.0001	0.833	0.543	1.123
1200 GMT	24-36	Local FP	.0001	0.800	0.619	0.981
		Guidance	.0001	0.741	0.566	0.917
	36-48	Local FP	.0001	0.923	0.721	1.126
		Guidance	.0001	0.773	0.616	0.930
	12-24	Local FP	.0001	0.489	0.353	0.625
		Guidance	.0001	0.833	0.557	1.109
Combined	24-36	Local FP	.0001	0.808	0.644	0.972
		Guidance	.0001	0.778	0.614	0.941
	36-48	Local FP	.0001	0.892	0.709	1.074
		Guidance	.0001	0.764	0.636	0.892

Table 5. Time series of national mean absolute errors (°F) for NWS maximum/minimum temperature forecasts during the warm season.

Verification Period	Type of Forecast	Lead Time (h) 12-24 0000/1200 GMT Max/Min	24-36 0000/1200 GMT Min/Max	36-48 0000/1200 GMT Max/Min	48-60 0000/1200 GMT Min/Max
1966	Local FP	3.2/3.1	3.5/3.9	4.6/4.0	--/--
	Guidance	4.5/4.0	4.6/4.9	5.9/4.9	--/--
	No. Cases	14571/14756	14737/14557	14560/14754	
1967	Local FP	3.2/3.0	3.5/3.8	4.5/3.9	--/--
	Guiadance	4.3/3.8	4.3/4.9	5.4/4.6	--/--
	No. Cases	14694/14794	14796/14695	14688/14790	
1968	Local FP	3.1/3.0	3.4/3.8	4.3/3.8	--/--
	Guidance	3.9/3.7	4.1/4.6	4.8/4.4	--/--
	No. Cases	14816/14816	14813/14812	14810/14814	
1969	Local FP	3.0/2.9	3.3/3.6	4.2/3.7	--/--
	Guidance	3.8/3.5	3.8/4.4	4.7/4.1	--/--
	No. Cases	15358/15360	15364/15348	15354/15361	
1970	Local FP	3.0/2.8	3.2/3.5	4.0/3.6	--/--
	Guidance	3.6/3.2	3.5/4.1	4.3/3.8	--/--
	No. Cases	10960/10607	10978/10588	10817/10607	
1971	Local FP	3.1/2.9	3.3/3.6	4.1/3.7	--/--
	Guidance	3.6/3.4	3.7/4.2	4.3/4.0	--/--
	No. Cases	13511/13254	13514/13245	13507/13266	
1972	Local FP	3.2/3.0	3.3/3.7	4.2/3.8	--/--
	Guidance	3.8/3.5	3.7/4.3	4.4/4.2	--/--
	No. Cases	14769/14678	14763/14671	14758/14667	
1973	Local FP	3.1/3.0	3.3/3.6	4.1/3.8	--/--
	Guidance	4.0/3.6	3.9/4.4	4.5/4.2	--/--
	No. Cases	14440/14319	14405/14321	14397/14320	
1974	Local FP	3.0/3.0	3.3/3.6	4.0/3.7	--/--
	Guidance	3.3/3.2	3.4/4.1	4.2/3.8	--/--
	No. Cases	14944/15345	14099/15113	14258/15002	
1975	Local FP	3.0/2.8	3.0/3.5	3.9/3.3	--/--
	Guidance	3.8/3.2	3.6/4.2	4.4/3.7	--/--
	No. Cases	10886/10746	10892/10733	10889/10775	
1976	Local FP	2.9/2.8	3.0/3.4	3.8/3.4	3.6/4.3
	Guidance	3.1/2.8	3.0/3.6	3.9/3.4	3.6/4.5
	No. Cases	12921/12770	12917/12769	12922/12772	12785/12633
1977	Local FP	2.9/2.8	3.0/3.4	3.8/3.4	3.7/4.2
	Guidance	3.1/2.9	3.1/3.7	4.0/3.4	3.7/4.5
	No. Cases	12942/13242	12970/13183	12939/13252	12974/13189

Table 5. (continued).

Verification Period	Type of Forecast	Lead Time (h) 12-24 0000/1200 GMT Max/Min	24-36 0000/1200 GMT Min/Max	36-48 0000/1200 GMT Max/Min	48-60 0000/1200 GMT Min/Max
	Local FP	3.0/3.0	3.2/3.5	3.9/3.6	3.8/4.4
1978	Guidance	3.4/3.2	3.4/4.0	4.3/3.7	3.9/4.7
	No. Cases	12047/12103	11966/12049	11894/12047	11890/11977
	Local FP	3.0/2.9	3.2/3.5	3.9/3.6	3.9/4.4
1979	Guidance	3.4/3.2	3.5/3.8	4.2/3.8	4.0/4.7
	No. Cases	9047/9928	8990/8997	8601/8986	8678/8751
	Local FP	3.0/3.0	3.2/3.4	3.8/3.6	3.8/4.1
1980	Guidance	3.3/3.1	3.3/3.7	4.0/3.6	3.9/4.4
	No. Cases	10036/10381	10593/9404	9808/9990	10354/9282
	Local FP	3.0/3.0	3.2/3.3	3.7/3.7	4.0/4.1
1981	Guidance	3.2/3.2	3.4/3.6	3.9/3.8	4.1/4.2
	No. Cases	10624/11484	10484/10844	10397/10567	10272/10617
	Local FP	3.0/2.9	3.1/3.3	3.7/3.4	3.6/4.1
1982	Guidance	3.0/3.0	3.1/3.4	3.8/3.4	3.6/4.0
	No. Cases	4913/4426	5092/4342	4924/4394	5050/4308
	Local FP	2.9/2.8	3.0/3.3	3.8/3.3	3.7/4.2
1983	Guidance	3.0/3.0	3.2/3.4	3.8/3.5	3.8/4.2
	No. Cases	6504/6128	6556/6052	6550/6121	6560/6089
	Local FP	2.9/2.8	3.0/3.3	3.7/3.4	3.7/4.1
1984	Guidance	3.1/3.1	3.2/3.6	3.7/3.6	3.8/4.2
	No. Cases	12641/12601	12663/12579	12626/12607	12635/12527
	Local FP	2.8/2.7	2.9/3.2	3.5/3.2	3.5/4.0
1985	Guidance	3.2/3.1	3.1/3.5	3.7/3.4	3.6/4.2
	No. Cases	13479/13309	13363/13399	13465/13278	13311/13377

Table 6. Trends in the accuracy of warm season NWS temperature forecasts as indicated by slopes (°F/year) of regression lines fitted to the time series of mean absolute errors, and p-values and confidence intervals associated with those slopes. Slopes which are not statistically significant (p-value $\geq$.05) are highlighted by the double asterisk (**).

Forecast Cycle	Lead Time (h)	Type of Forecast	P-value	Slope	95% Interval Lower	Upper
0000 GMT	12-24 (Max)	Local FP	.0001	-.014	-.008	-.020
		Guidance	.0001	-.063	-.043	-.082
	24-36 (Min)	Local FP	.0001	-.024	-.015	-.032
		Guidance	.0001	-.060	-.040	-.080
	36-48 (Max)	Local FP	.0001	-.044	-.035	-.053
		Guidance	.0001	-.081	-.057	-.105
	48-60 (Min)	Local FP	.4720**	-.013	.026	-.052
		Guidance	.8192**	-.005	.042	-.064
1200 GMT	12-24 (Min)	Local FP	.0226	-.009	-.001	-.017
		Guidance	.0001	-.041	-.024	-.057
	24-36 (Max)	Local FP	.0001	-.030	-.024	-.036
		Guidance	.0001	-.073	-.058	-.088
	36-48 (Min)	Local FP	.0001	-.029	-.017	-.040
		Guidance	.0001	-.059	-.039	-.079
	48-60 (Max)	Local FP	.0215	-.032	-.006	-.058
		Guidance	.0135	-.058	-.016	-.101
Max/Min Combined	12-24	Local FP	.0010	-.011	-.005	-.017
		Guidance	.0001	-.053	-.036	-.070
	24-36	Local FP	.0001	-.029	-.021	-.036
		Guidance	.0001	-.068	-.051	-.085
	36-48	Local FP	.0001	-.035	-.026	-.045
		Guidance	.0001	-.069	-.048	-.089
	48-60	Local FP	.1511**	-.022	.010	-.054
		Guidance	.1547**	-.029	.014	-.072

Table 7. Same as Table 5 except for the percentage of errors >10°F.

Verification Period	Type of Forecast	Lead Time (h) 12-24 0000/1200 GMT Max/Min	24-36 0000/1200 GMT Min/Max	36-48 0000/1200 GMT Max/Min	48-60 0000/1200 GMT Min/Max
1966	Local FP	3.3/1.7	3.2/5.7	9.2/5.4	--/--
	Guidance	8.9/5.0	8.5/11.0	16.2/10.0	--/--
	No. Cases	14571/14756	14737/14557	14560/14754	
1967	Local FP	3.2/1.8	2.9/5.9	8.7/5.2	--/--
	Guiadance	7.6/4.8	7.1/10.6	13.8/8.1	--/--
	No. Cases	14694/14794	14796/14695	14688/14790	
1968	Local FP	2.8/1.6	2.9/5.2	7.9/4.8	--/--
	Guidance	5.7/3.9	5.3/8.8	10.3/7.2	--/--
	No. Cases	14816/14816	14813/14812	14810/14814	
1969	Local FP	2.3/1.2	2.4/4.5	7.1/4.0	--/--
	Guidance	5.2/3.4	4.4/8.1	9.3/5.5	--/--
	No. Cases	15358/15360	15364/15348	15354/15361	
1970	Local FP	2.5/1.3	1.9/4.2	6.3/3.4	--/--
	Guidance	4.3/2.1	2.5/5.6	7.2/4.1	--/--
	No. Cases	10960/10607	10978/10588	10817/10607	
1971	Local FP	2.7/1.4	2.4/4.6	6.4/4.1	--/--
	Guidance	4.7/2.7	3.6/6.6	6.8/5.2	--/--
	No. Cases	13511/13254	13514/13245	13507/13266	
1972	Local FP	3.1/1.7	2.6/5.0	7.2/4.5	--/--
	Guidance	5.9/3.0	3.7/6.9	8.0/5.8	--/--
	No. Cases	14769/14678	14763/14671	14758/14667	
1973	Local FP	2.6/1.5	2.4/4.2	6.5/4.3	--/--
	Guidance	5.9/3.6	4.3/6.8	8.0/5.9	--/--
	No. Cases	14440/14319	14405/14321	14397/14320	
1974	Local FP	2.5/1.5	2.3/4.6	6.4/4.0	--/--
	Guidance	3.5/2.1	2.5/6.4	6.8/3.7	--/--
	No. Cases	14944/15345	14099/15113	14258/15002	
1975	Local FP	2.4/1.0	1.6/4.0	5.2/2.4	--/--
	Guidance	5.8/2.6	3.5/7.1	8.1/3.9	--/--
	No. Cases	10886/10746	10892/10733	10889/10775	
1976	Local FP	2.1/1.1	1.7/3.4	5.1/2.7	3.2/7.5
	Guidance	1.7/1.1	1.4/3.3	4.6/2.4	3.0/7.5
	No. Cases	12921/12770	12917/12769	12922/12772	12785/12633
1977	Local FP	2.5/1.1	1.7/3.7	4.8/2.6	3.6/7.2
	Guidance	2.1/1.2	1.7/3.5	5.0/2.5	3.9/7.6
	No. Cases	12942/13242	12970/13183	12939/13252	12974/13189

Table 7. (continued).

Verification Period	Type of Forecast	Lead Time (h) 12-24 0000/1200 GMT Max/Min	24-36 0000/1200 GMT Min/Max	36-48 0000/1200 GMT Max/Min	48-60 0000/1200 GMT Min/Max
1978	Local FP	2.3/1.2	1.8/4.0	5.3/3.1	3.8/7.7
	Guidance	2.8/1.8	2.5/4.4	5.8/3.3	3.9/8.1
	No. Cases	12047/12103	11966/12049	11894/12047	11890/11977
1979	Local FP	2.0/1.3	1.7/3.7	5.5/2.7	3.8/7.8
	Guidance	3.1/2.2	2.9/4.5	6.0/3.8	4.6/8.7
	No. Cases	9047/9928	8990/8997	8601/8986	8678/8751
1980	Local FP	2.2/1.5	1.6/3.0	5.1/2.7	3.9/6.3
	Guidance	3.3/1.4	2.2/4.1	5.3/3.1	4.4/7.1
	No. Cases	10036/10381	10593/9404	9808/9990	10354/9282
1981	Local FP	2.3/1.1	1.9/3.4	4.6/3.4	4.7/6.8
	Guidance	3.0/1.5	2.3/3.9	5.2/3.6	4.7/6.7
	No. Cases	10624/11484	10484/10844	10397/10567	10272/10617
1982	Local FP	2.5/1.0	1.5/3.4	5.1/2.3	3.3/6.4
	Guidance	2.1/1.0	1.6/3.4	4.9/2.3	3.2/5.5
	No. Cases	4913/4426	5092/4342	4924/4394	5050/4308
1983	Local FP	2.2/0.9	1.3/3.1	4.8/2.1	3.5/6.7
	Guidance	2.1/1.1	1.5/3.2	4.7/2.2	3.9/6.4
	No. Cases	6504/6128	6556/6052	6550/6121	6560/6089
1984	Local FP	2.4/0.9	1.5/3.8	4.9/2.5	4.0/6.9
	Guidance	2.8/1.2	1.9/4.4	4.8/2.9	4.3/7.1
	No. Cases	12641/12601	12663/12579	12626/12607	12635/12527
1985	Local FP	1.8/0.8	1.1/3.2	4.6/1.8	3.0/6.3
	Guidance	2.8/1.6	1.3/4.1	4.9/2.2	2.8/7.2
	No. Cases	13479/13309	13363/13399	13465/13278	13311/13377

Table 8. Same as Table 6 except for the percentage of errors >10°F. In this case, the slopes are given in %/year.

Forecast Cycle	Lead Time (h)	Type of Forecast	P-value	Slope	95% Interval Lower	95% Interval Upper
	12-24	Local FP	.0002	-.049	-.027	-.070
	(Max)	Guidance	.0001	-.272	-.175	-.369
	24-36	Local FP	.0001	-.088	-.067	-.110
	(Min)	Guidance	.0001	-.265	-.171	-.359
0000 GMT						
	36-48	Local FP	.0001	-.209	-.157	-.261
	(Max)	Guidance	.0001	-.435	-.286	-.587
	48-60	Local FP	.9004**	-.007	.123	-.137
	(Min)	Guidance	.8274**	-.018	.162	-.197
	12-24	Local FP	.0001	-.039	-.024	-.055
	(Min)	Guidance	.0001	-.178	-.123	-.232
	24-36	Local FP	.0001	-.125	-.091	-.158
	(Max)	Guidance	.0001	-.349	-.248	-.449
1200 GMT						
	36-48	Local FP	.0001	-.159	-.116	-.202
	(Min)	Guidance	.0001	-.308	-.213	-.403
	48-60	Local FP	.0242	-.131	-.022	-.240
	(Max)	Guidance	.1321**	-.150	.056	-.356
	12-24	Local FP	.0001	-.043	-.026	-.060
		Guidance	.0001	-.225	-.152	-.299
	24-36	Local FP	.0001	-.104	-.079	-.130
Max/Min Combined		Guidance	.0001	-.305	-.212	-.399
	36-48	Local FP	.0001	-.183	-.139	-.227
		Guidance	.0001	-.369	-.251	-.488
	48-60	Local FP	.1476**	-.069	.030	-.168
		Guidance	.2532**	-.086	.075	-.247

Table 9. Same as Table 5 except for the cool season.

Verification Period	Type of Forecast	Lead Time (h) 12-24 0000/1200 GMT Max/Min	24-36 0000/1200 GMT Min/Max	36-48 0000/1200 GMT Max/Min	48-60 0000/1200 GMT Min/Max
1966-67	Local FP	3.8/3.9	4.8/4.7	5.5/5.6	--/--
	Guidance	4.9/5.2	6.0/6.0	6.5/6.6	--/--
	No. Cases	14708/14451	14692/14676	14658/14479	
1967-68	Local FP	3.8/3.8	4.6/4.6	5.5/5.2	--/--
	Guidance	4.8/4.8	5.6/5.5	6.2/6.0	--/--
	No. Cases	14789/14375	14781/14721	14763/14422	
1968-69	Local FP	3.6/3.8	4.5/4.4	5.1/5.1	--/--
	Guidance	4.6/4.8	5.3/5.3	5.7/5.7	--/--
	No. Cases	14990/15001	14988/14991	14968/14988	
1969-70	Local FP	3.7/3.8	4.5/4.4	5.2/5.2	--/--
	Guidance	4.6/4.7	5.4/5.5	5.8/5.7	--/--
	No. Cases	15385/15382	15375/15368	15355/15345	
1970-71	Local FP	3.6/3.9	4.6/4.3	4.9/5.3	--/--
	Guidance	4.4/4.9	5.4/5.1	5.4/5.8	--/--
	No. Cases	13129/12922	13132/12914	13139/12870	
1971-72	Local FP	3.7/3.9	4.6/4.5	5.1/5.3	--/--
	Guidance	4.7/4.8	5.1/5.2	5.5/5.5	--/--
	No. Cases	13142/13527	13116/13462	13112/13498	
1972-73	Local FP	3.7/3.7	4.4/4.4	5.1/4.9	--/--
	Guidance	4.8/4.6	5.0/5.2	5.7/5.2	--/--
	No. Cases	14691/14936	14688/14924	14664/14926	
1973-74	Local FP	3.5/3.9	4.6/4.2	4.9/5.2	--/--
	Guidance	3.9/4.6	5.2/4.6	4.9/5.4	--/--
	No. Cases	13830/14709	13101/14622	13009/14666	
1974-75	Local FP	3.5/3.9	4.4/4.2	4.7/5.1	--/--
	Guidance	3.9/4.6	5.1/4.6	4.7/5.4	--/--
	No. Cases	14410/14199	14441/14137	14395/14178	
1975-76	Local FP	3.5/3.9	4.3/4.0	4.7/5.0	5.5/5.5
	Guidance	3.8/4.4	4.6/4.3	4.9/5.1	5.5/5.5
	No. Cases	13053/12939	11629/12606	13054/12947	11602/12647
1976-77	Local FP	3.4/3.8	4.1/4.0	4.5/4.7	5.0/5.3
	Guidance	3.9/4.2	4.3/4.5	4.8/4.9	5.1/5.4
	No. Cases	13935/13876	12070/13297	13935/13871	11968/13331
1977-78	Local FP	3.4/3.8	4.1/4.0	4.5/4.8	5.1/5.1
	Guidance	3.8/4.5	4.5/4.3	4.6/5.1	5.3/5.2
	No. Cases	11994/12409	10464/11699	11986/12412	10370/11748

Table 9. (continued).

Verification Period	Type of Forecast	Lead Time (h) 12-24 0000/1200 GMT Max/Min	24-36 0000/1200 GMT Min/Max	36-48 0000/1200 GMT Max/Min	48-60 0000/1200 GMT Min/Max
	Local FP	3.4/4.0	4.5/4.1	4.6/5.1	5.6/5.2
1978-79	Guidance	4.0/4.9	5.4/4.6	5.1/5.7	5.9/5.6
	No. Cases	12554/12939	12526/12582	12442/12550	12418/12501
	Local FP	3.4/3.9	4.4/3.9	4.3/5.1	5.4/4.9
1979-80	Guidance	4.0/4.7	5.3/4.4	4.9/5.7	5.8/5.3
	No. Cases	9457/10067	9634/9379	9157/9527	9374/9104
	Local FP	3.3/3.8	4.3/3.9	4.4/4.9	5.3/5.0
1980-81	Guidance	3.7/4.5	4.8/4.2	4.5/5.4	5.6/5.1
	No. Cases	10680/11510	10635/10566	10448/10523	10406/10312
	Local FP	3.3/3.7	4.1/3.9	4.3/4.8	5.4/4.9
1981-82	Guidance	3.5/4.4	4.7/4.1	4.4/5.3	5.8/5.0
	No. Cases	7936/7882	8175/7666	7918/7887	8179/7637
	Local FP	3.2/3.6	4.1/3.8	4.2/4.9	5.4/4.8
1982-83	Guidance	3.5/4.6	5.1/4.0	4.3/5.9	6.2/5.0
	No. Cases	8311/7246	8118/7305	8221/7165	8108/7257
	Local FP	3.2/3.7	4.1/3.8	4.3/4.8	5.3/4.9
1983-84	Guidance	3.8/4.7	5.0/4.3	4.7/5.6	5.8/5.4
	No. Cases	10534/10382	10519/10371	10514/10360	10480/10313
	Local FP	3.2/3.5	4.0/3.9	4.3/4.6	5.2/4.8
1984-85	Guidance	3.8/4.7	4.9/4.3	4.5/5.4	5.7/5.0
	No. Cases	12925/12722	12708/12892	12898/12685	12638/12850
	Local FP	3.1/3.4	3.8/3.8	4.2/4.4	4.9/4.8
1985-86	Guidance	3.7/4.1	4.2/4.4	4.6/4.8	5.2/5.3
	No. Cases	13117/13022	13026/13132	13126/12996	12967/13083

Table 10. Same as Table 6 except for the cool season.

Forecast Cycle	Lead Time (h)	Type of Forecast	P-value	Slope	95% Interval Lower	95% Interval Upper
0000 GMT	12-24 (Max)	Local FP	.0001	-.034	-.030	-.039
		Guidance	.0001	-.068	-.048	-.088
	24-36 (Min)	Local FP	.0001	-.038	-.027	-.049
		Guidance	.0023	-.048	-.020	-.076
	36-48 (Max)	Local FP	.0001	-.068	-.058	-.079
		Guidance	.0001	-.094	-.069	-.118
	48-60 (Min)	Local FP	.4003**	-.018	.028	-.065
		Guidance	.4131**	-.027	.099	-.045
1200 GMT	12-24 (Min)	Local FP	.0049	-.015	-.005	-.025
		Guidance	.0090	-.024	-.007	-.041
	24-36 (Max)	Local FP	.0001	-.045	-.037	-.053
		Guidance	.0001	-.084	-.062	-.106
	36-48 (Min)	Local FP	.0001	-.038	-.025	-.052
		Guidance	.0265	-.034	-.005	-.064
	48-60 (Max)	Local FP	.0002	-.063	-.040	-.086
		Guidance	.1182**	-.032	-.010	-.073
Max/Min Combined	12-24	Local FP	.0010	-.025	-.018	-.033
		Guidance	.0001	-.046	-.031	-.061
	24-36	Local FP	.0001	-.042	-.033	-.051
		Guidance	.0001	-.065	-.043	-.087
	36-48	Local FP	.0001	-.055	-.046	-.063
		Guidance	.0001	-.066	-.043	-.088
	48-60	Local FP	.0035	-.045	-.019	.070
		Guidance	.9143**	-.002	-.035	.039

Table 11. Same as Table 5 except for the percentage of errors >10°F during the cool season.

Verification Period	Type of Forecast	Lead Time (h) 12-24 0000/1200 GMT Max/Min	24-36 0000/1200 GMT Min/Max	36-48 0000/1200 GMT Max/Min	48-60 0000/1200 GMT Min/Max
	Local FP	4.6/4.9	9.4/8.9	13.9/14.0	--/--
1966-67	Guidance	10.1/11.1	16.8/16.7	19.9/20.2	--/--
	No. Cases	14708/14451	14692/14676	14658/14479	
	Local FP	4.4/4.0	8.2/8.5	13.4/11.7	--/--
1967-68	Guidance	9.4/9.0	13.3/13.6	17.9/16.4	--/--
	No. Cases	14789/14375	14781/14721	14763/14422	
	Local FP	3.9/4.0	7.4/7.3	11.4/10.8	--/--
1968-69	Guidance	8.3/8.5	11.5/12.1	15.1/14.3	--/--
	No. Cases	14990/15001	14988/14991	14968/14988	
	Local FP	3.9/3.8	7.4/7.4	12.2/11.7	--/--
1969-70	Guidance	7.6/8.2	11.8/13.3	15.4/14.4	--/--
	No. Cases	15385/15382	15375/15368	15355/15345	
	Local FP	3.5/4.7	8.0/6.8	10.3/12.4	--/--
1970-71	Guidance	7.4/9.7	12.9/10.5	12.4/15.6	--/--
	No. Cases	13129/12922	13132/12914	13139/12870	
	Local FP	4.8/4.8	7.9/8.3	11.6/12.3	--/--
1971-72	Guidance	8.9/9.3	11.1/11.4	13.3/13.3	--/--
	No. Cases	13142/13527	13116/13462	13112/13498	
	Local FP	4.1/3.8	6.4/7.4	11.3/9.2	--/--
1972-73	Guidance	9.6/7.4	9.8/12.	15.3/11.2	--/--
	No. Cases	14691/14936	14688/14924	14664/14926	
	Local FP	3.7/4.6	8.0/6.8	10.4/11.7	--/--
1973-74	Guidance	5.1/7.8	11.2/8.1	10.6/13.3	--/--
	No. Cases	13830/14709	13101/14622	13009/14666	
	Local FP	3.4/4.6	6.5/6.3	8.5/10.4	--/--
1974-75	Guidance	5.1/7.5	10.6/7.8	8.3/11.8	--/--
	No. Cases	14410/14199	14441/14137	14395/14178	
	Local FP	3.5/4.3	6.3/5.6	9.0/10.4	12.7/13.7
1975-76	Guidance	4.7/7.0	7.8/6.8	9.5/10.9	12.9/14.0
	No. Cases	13053/12939	11629/12606	13054/12947	11602/12647
	Local FP	3.1/3.9	5.3/5.1	7.5/8.3	10.5/11.7
1976-77	Guidance	4.2/5.8	6.0/6.8	8.8/9.1	10.6/12.6
	No. Cases	13935/13876	12070/13297	13935/13871	11968/13331
	Local FP	3.0/3.8	4.7/5.5	7.4/9.4	10.6/11.2
1977-78	Guidance	4.4/7.0	7.1/7.0	8.4/11.0	11.5/11.6
	No. Cases	11994/12409	10464/11699	11986/12412	10370/11748

Table 11. (continued).

Verification Period	Type of Forecast	Lead Time (h) 12-24 0000/1200 GMT Max/Min	24-36 0000/1200 GMT Min/Max	36-48 0000/1200 GMT Max/Min	48-60 0000/1200 GMT Min/Max
1978-79	Local FP	3.0/4.6	7.1/5.5	8.0/10.3	13.2/11.1
	Guidance	4.9/9.2	12.2/7.5	10.6/14.2	15.6/14.0
	No. Cases	12554/12939	12526/12582	12442/12550	12418/12501
1979-80	Local FP	2.6/4.3	6.5/4.9	6.6/10.5	12.3/10.1
	Guiadance	5.0/8.4	11.7/7.2	9.5/14.4	15.1/11.7
	No. Cases	9457/10067	9634/9379	9157/9527	9374/9104
1980-81	Local FP	2.3/3.6	5.9/4.6	6.9/9.0	11.8/9.9
	Guidance	3.8/6.5	8.6/4.9	7.5/11.6	13.6/11.1
	No. Cases	10686/11510	10635/10566	10448/10523	10406/10312
1981-82	Local FP	2.2/3.4	5.3/4.7	6.7/8.9	12.2/10.1
	Guidance	3.4/6.4	8.5/5.0	7.0/12.2	15.4/10.3
	No. Cases	7936/7882	8175/7666	7918/7887	8179/7637
1982-83	Local FP	1.9/2.7	5.1/4.2	5.9/9.2	12.4/9.1
	Guidance	2.9/7.2	10.7/4.9	6.7/16.0	18.1/10.5
	No. Cases	8311/7246	8118/7305	8221/7165	8108/7257
1983-84	Local FP	2.4/3.1	5.2/4.2	6.8/8.1	11.6/10.3
	Guidance	4.5/7.6	9.6/7.2	8.3/13.7	15.2/12.9
	No. Cases	10534/10382	10519/10371	10514/10360	10480/10313
1984-85	Local FP	2.0/2.8	4.8/4.5	6.3/8.1	11.3/8.9
	Guidance	4.3/8.3	9.5/6.4	7.5/12.7	14.4/10.1
	No. Cases	12925/12722	12708/12892	12898/12685	12638/12850
1985-86	Local FP	2.1/2.8	3.9/4.1	6.3/6.7	9.9/9.7
	Guidance	4.3/4.8	5.4/7.5	8.9/9.0	11.1/12.3
	No. Cases	13117/13022	13026/13132	13126/12996	12967/13083

Table 12. Same as Table 6 except for the percentage of errors >10°F during the cool season. In this case, the slopes are given in %/year.

Forecast Cycle	Lead Time (h)	Type of Forecast	P-value	Slope	95% Interval Lower	Upper
	12-24	Local FP	.0001	-.142	-.115	-.169
	(Max)	Guidance	.0001	-.331	-.232	-.431
	24-36	Local FP	.0001	-.213	-.154	-.272
	(Min)	Guidance	.0020	-.229	-.122	-.463
0000 GMT						
	36-48	Local FP	.0001	-.412	-.343	-.481
	(Max)	Guidance	.0001	-.567	-.406	-.727
	48-60	Local FP	.4032**	-.086	.136	-.309
	(Min)	Guidance	.3706**	.205	.699	-.288
	12-24	Local FP	.0003	-.085	-.044	-.125
	(Min)	Guidance	.0024	-.157	-.063	-.250
	24-36	Local FP	.0001	-.249	-.208	-.289
	(Max)	Guidance	.0001	-.480	-.337	-.622
1200 GMT						
	36-48	Local FP	.0001	-.259	-.180	-.338
	(Min)	Guidance	.0264	-.221	-.029	-.413
	48-60	Local FP	.0011	-.345	-.178	-.511
	(Max)	Guidance	.1146**	-.209	.062	-.480
	12-24	Local FP	.0001	-.114	-.087	-.141
		Guidance	.0001	-.245	-.167	-.324
	24-36	Local FP	.0001	-.230	-.189	-.271
Max/Min		Guidance	.0001	-.383	-.253	-.513
Combined						
	36-48	Local FP	.0001	-.337	-.283	-.390
		Guidance	.0001	-.397	-.251	-.543
	48-60	Local FP	.0054	-.212	-.080	-.344
		Guidance	.9637**	-.005	.258	-.269

Table 13. Data ID's for forecasts and observations in NWS verification data.

Weather Element	Type of Data	Data ID	Projections (taus)	Units
Max temp	MOS forecast	2000	24,36,48,60	°F
Max temp	Local FP forecast	2050	24,36,48,60	°F
Max temp	Observation	2090	24,36,48,60	°F
Min temp	MOS forecast	2100	24,36,48,60	°F
Min temp	Local FP forecast	2150	24,36,48,60	°F
Min temp	Observation	2190	24,36,48,60	°F
PoP	MOS forecast	6100	24,36,48	0.0-1.0
PoP	Local FP forecast	6150	24,36,48	0.0-1.0
Precip amt	Observation	6190	24,36,48	Inches

Table 14. Categories of observed precipitation and the corresponding code for the period April 1966 through September 1983.

Code	Precipitation	Comments
0	0	Included "trace" prior to May 1971.
.004	trace	Used from May 1971 through September 1983 to indicate a trace amount during a 6-h period.
.008	2 traces	Used from May 1971 through September 1983 to indicate trace amounts during two, 6-h periods.
.10	.01 - .1	Used from August 1968 through September 1983.
.25	.11 - .25	Used from August 1968 through September 1983.
.50	.26 - .50	Used from August 1968 through September 1983.
.99	$\geq$.01	Used from April 1966 through July 1968.
1.0	.51 -1.00	Used from August 1968 through September 1983.
2.0	1.01 -2.00	Used from August 1968 through September 1983.
3.0	2.01 -3.00	Used from August 1968 through September 1983.
4.0	3.01 -4.00	Used from August 1968 through September 1983.
4.99	>4.00	Used from May 1971 through September 1983.
5.0	4.01 -5.00	Used from August 1968 through April 1971.
5.99	>5.00	Used from August 1968 through April 1971.

Table 15. Names, call letters, and WBAN numbers of the 100 stations in the FP/NMC verification archive network.

STATION NAME		CALL LETTERS	WBAN NUMBER	STATION NAME		CALL LETTERS	WBAN NUMBER
ABILENE	TX	ABI	13962	WILMINGTON	NC	ILM	13748
ALBUQUERQUE	NM	ABQ	23050	INDIANAPOLIS	IN	IND	93819
ALBANY	NY	ALB	14735	INTERNATIONAL FLS	MN	INL	14918
WATERLOO	IA	ALO	94910	WILLISTON	ND	ISN	94014
AMARILLO	TX	AMA	23047	JACKSON	MS	JAN	3940
ATLANTA	GA	ATL	13874	LAS VEGAS	NV	LAS	23169
ASHEVILLE	NC	AVL	3812	LOS ANGELES	CA	LAX	23174
HARTFORD	CT	BDL	14740	LUBBOCK	TX	LBB	23042
BIRMINGHAM	AL	BHM	13876	NORTH PLATTE	NE	LBF	24023
BILLINGS	MT	BIL	24033	NEW YORK-LAGUARD.	NY	LGA	14732
BISMARCK	ND	BIS	24011	LITTLE ROCK	AR	LIT	13963
NASHVILLE	TN	BNA	13897	LANDER	WY	LND	24021
BOISE	ID	BOI	24131	KANSAS CITY	MO	MCI	3947
BOSTON	MA	BOS	14739	CHICAGO-MIDWAY	IL	MDW	14819
BROWNSVILLE	TX	BRO	12919	MEMPHIS	TN	MEM	13893
BURLINGTON	VT	BTV	14742	MEDFORD	OR	MFR	24225
BUFFALO	NY	BUF	14733	MIAMI	FL	MIA	12839
COLUMBIA	SC	CAE	13883	MILWAUKEE	WI	MKE	14839
CLAYTON	NM	CAO	23051	MOBILE	AL	MOB	13894
CEDAR CITY	UT	CDC	93129	MINNEAPOLIS	MN	MSP	14922
CHARLESTON	SC	CHS	13880	NEW ORLEANS	LA	MSY	12916
CLEVELAND	OH	CLE	14820	OKLAHOMA CITY	OK	OKC	13967
CHARLOTTE	NC	CLT	13881	OMAHA	NE	OMA	14942
COLUMBUS	OH	CMH	14821	NORFOLK	VA	ORF	13737
CASPER	WY	CPR	24089	PORTLAND	OR	PDX	24229
CHARLESTON	WV	CRW	13866	PHILADELPHIA	PA	PHL	13739
CHEYENNE	WY	CYS	24018	PHOENIX	AZ	PHX	23183
DAGGETT	CA	DAG	23161	POCATELLO	ID	PIH	24156
WASHINGTON	DC	DCA	13743	PITTSBURGH	PA	PIT	94823
DODGE CITY	KS	DDC	13985	PROVIDENCE	RI	PVD	14765
DENVER	CO	DEN	23062	PORTLAND	ME	PWM	14764
DALLAS-FT.WO.	TX	DFW	3927	RAPID CITY	SD	RAP	24090
DULUTH	MN	DLH	14913	RALEIGH-DURHAM	NC	RDU	13722
DEL RIO	TX	DRT	22010	RENO	NV	RNO	23185
DES MOINES	IA	DSM	14933	ROSWELL	NM	ROW	23043
DETROIT	MI	DTW	94847	SACRAMENTO	CA	SAC	23232
EL PASO	TX	ELP	23044	SAN DIEGO	CA	SAN	23188
ELY	NV	ELY	23154	SAN ANTONIO	TX	SAT	12921
FARGO	ND	FAR	14914	SAVANNAH	GA	SAV	3822
FRESNO	CA	FAT	93193	LOUISVILLE	KY	SDF	93821
FLAGSTAFF	AZ	FLG	3103	SEATTLE-TACOMA	WA	SEA	24233
SIOUX FALLS	SD	FSD	14944	SAN FRANCISCO	CA	SFO	23234
FORT SMITH	AR	FSM	13964	SHREVEPORT	LA	SHV	13957
SPOKANE	WA	GEG	24157	SALT LAKE CITY	UT	SLC	24127
GLASGOW	MT	GGW	94008	SAULT STE MARIE	MI	SSM	14847
GRAND JUNCTION	CO	GJT	23066	ST. LOUIS	MO	STL	13994
GREAT FALLS	MT	GTF	24143	SYRACUSE	NY	SYR	14771
HELENA	MT	HLN	24144	TAMPA	FL	TPA	12842
HOUSTON	TX	IAH	12960	TULSA	OK	TUL	13968
WICHITA	KS	ICT	3928	TUCSON	AZ	TUS	23160

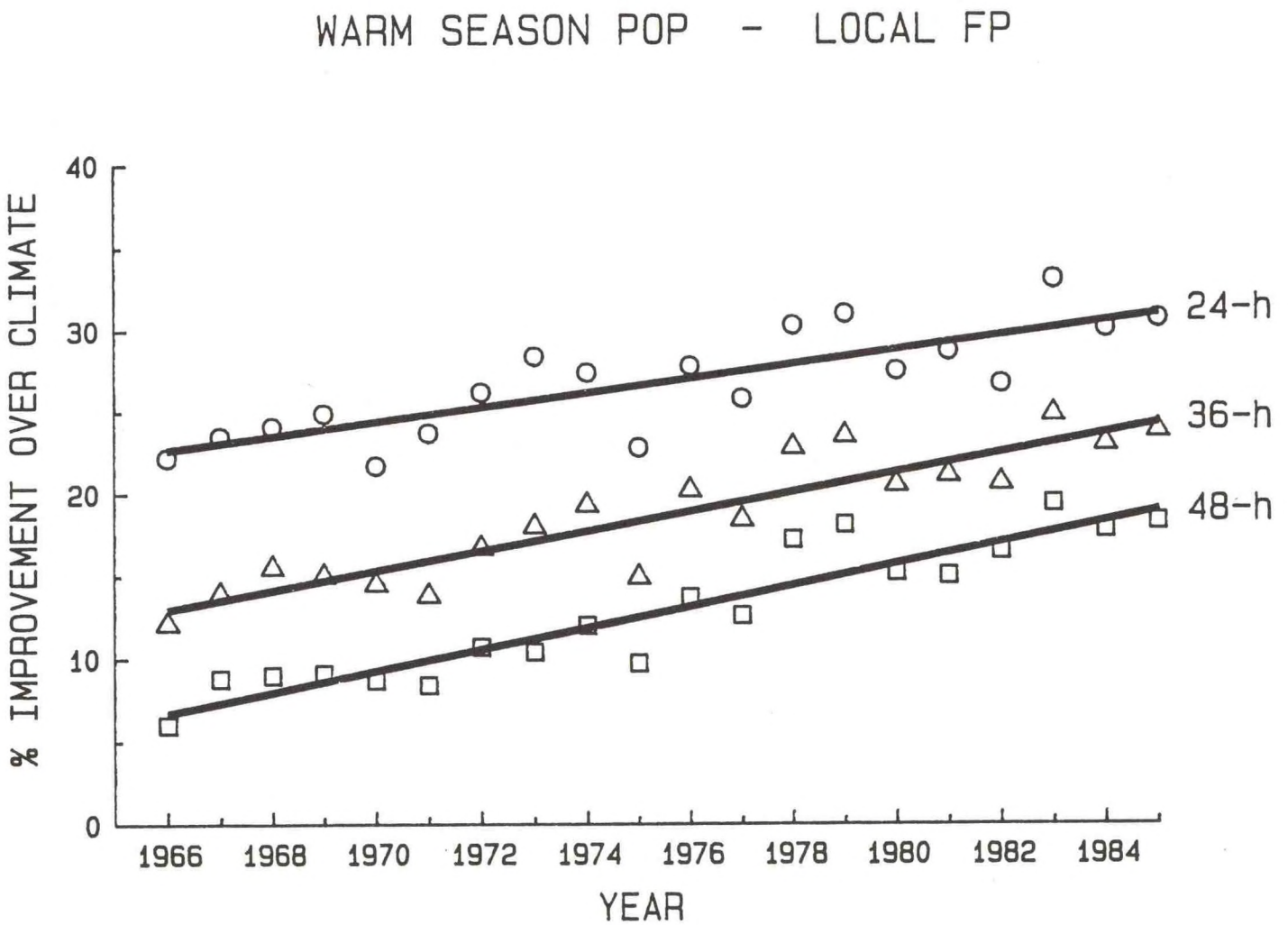

Figure 1. Time series of national skill score in terms of percent improvement over climate of the NWS Brier score for the local FP PoP forecasts during the warm season months of April through September. For each forecast projection, a linear regression line which best fits the data indicates the long-term trend in the scores.

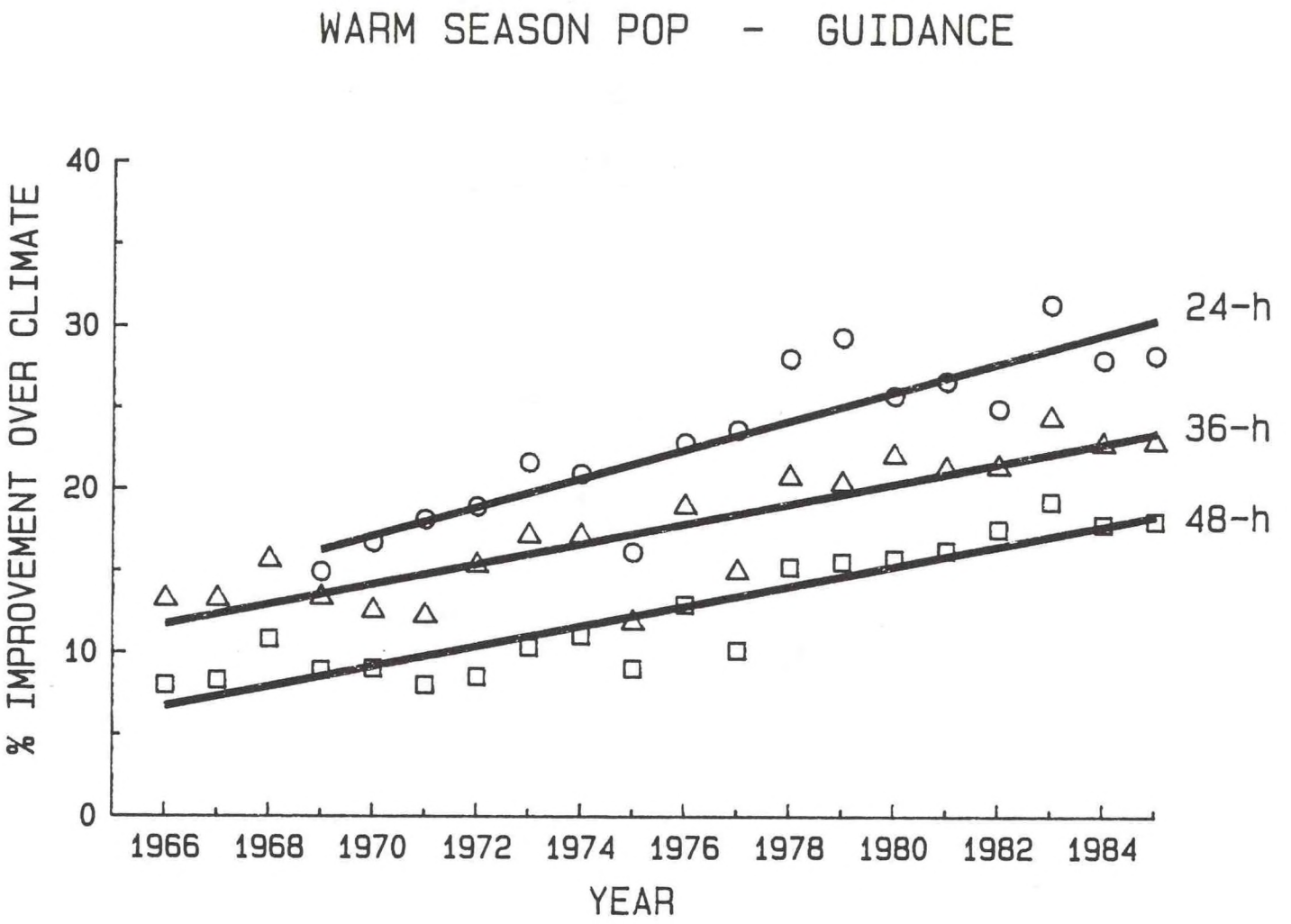

Figure 2. Same as Fig. 1 except for the guidance PoP forecasts.

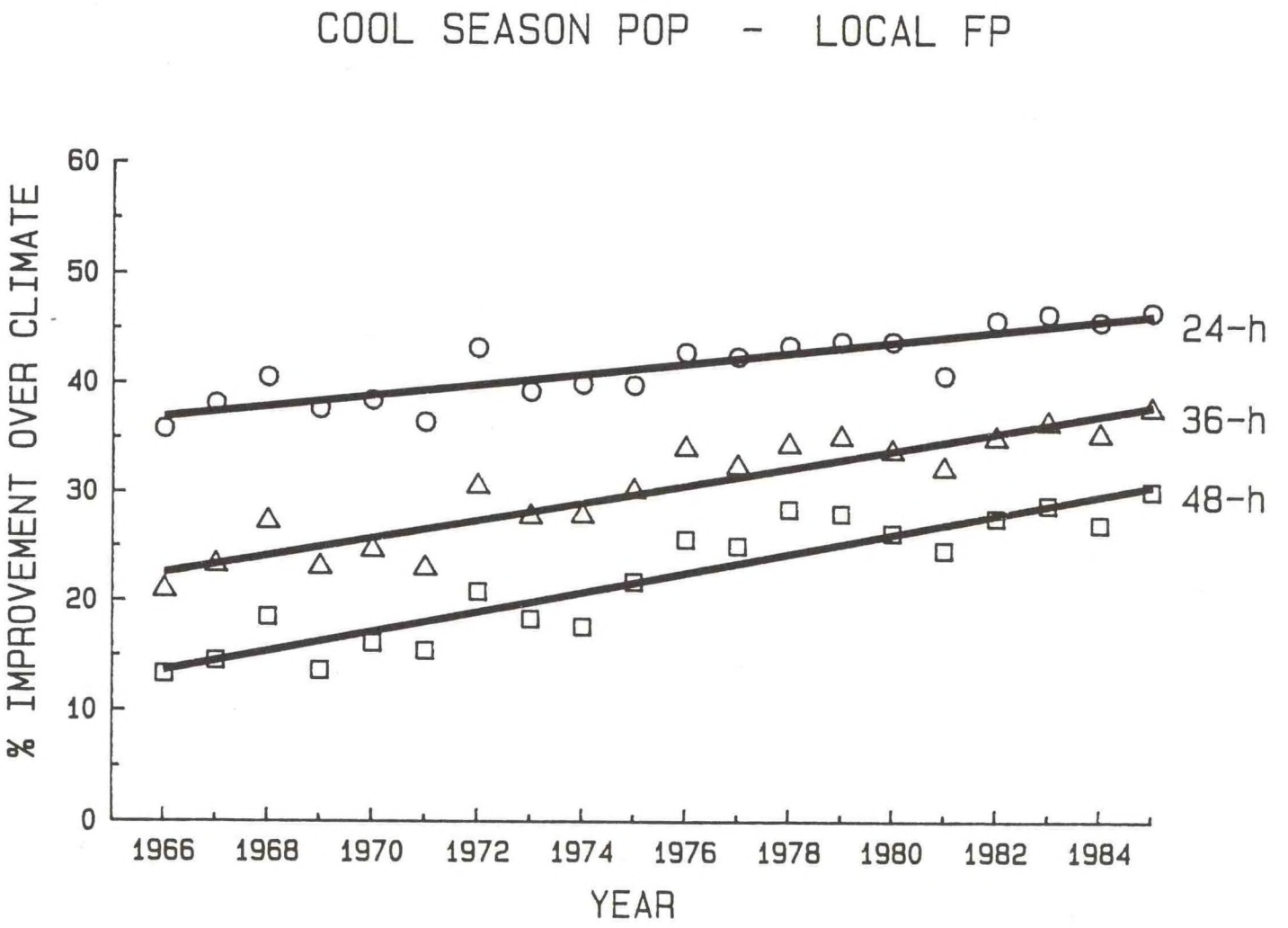

Figure 3. Same as Fig. 1 except for the cool season months of October through March. For the abscissa, 1966 denotes the 1966-67 cool season and so forth.

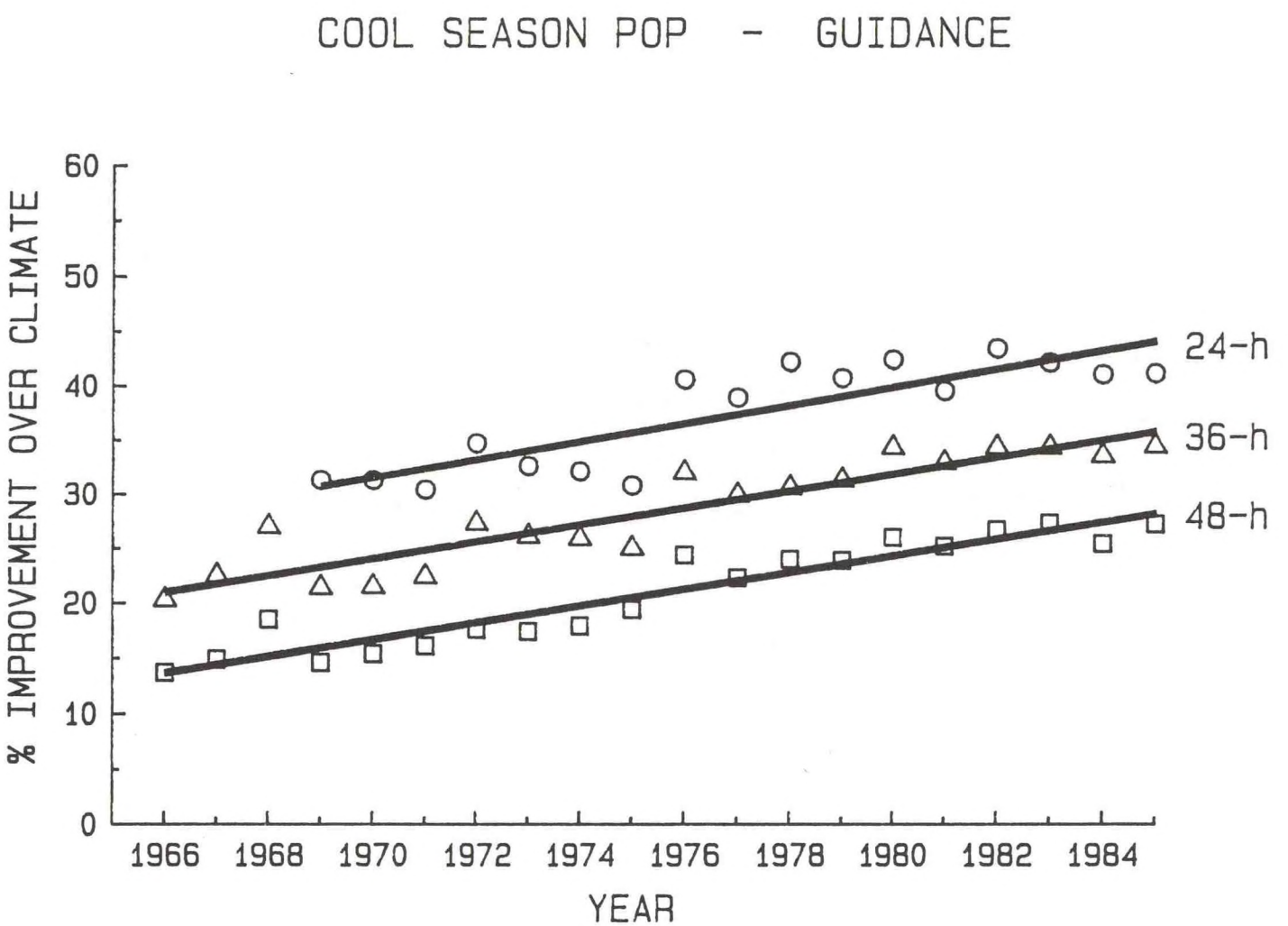

Figure 4. Same as Fig. 1 except for the cool season guidance PoP forecasts.

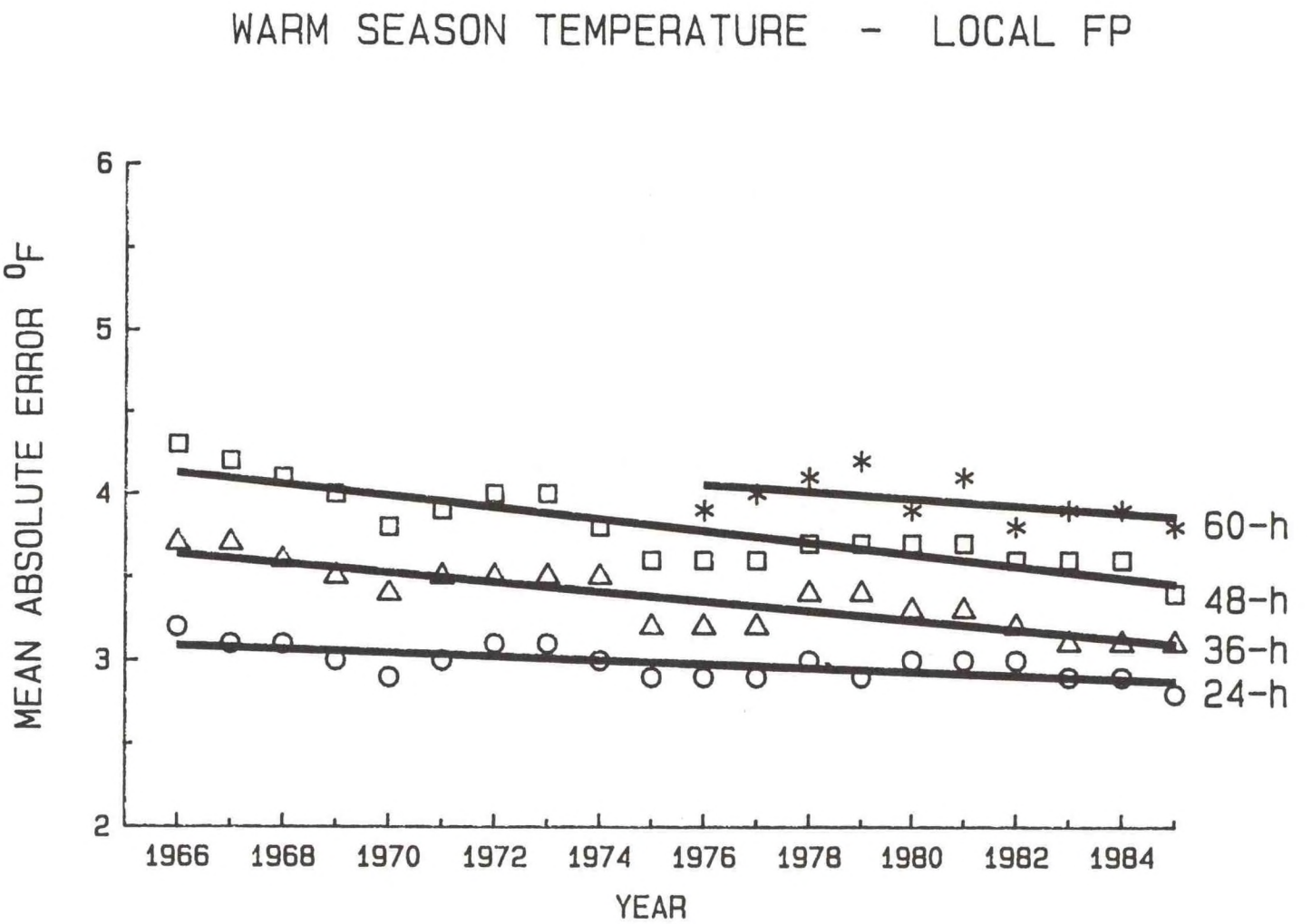

Figure 5. Time series of national mean absolute errors (°F) for the local FP temperature forecasts (maximum and minimum combined) during the warm season.

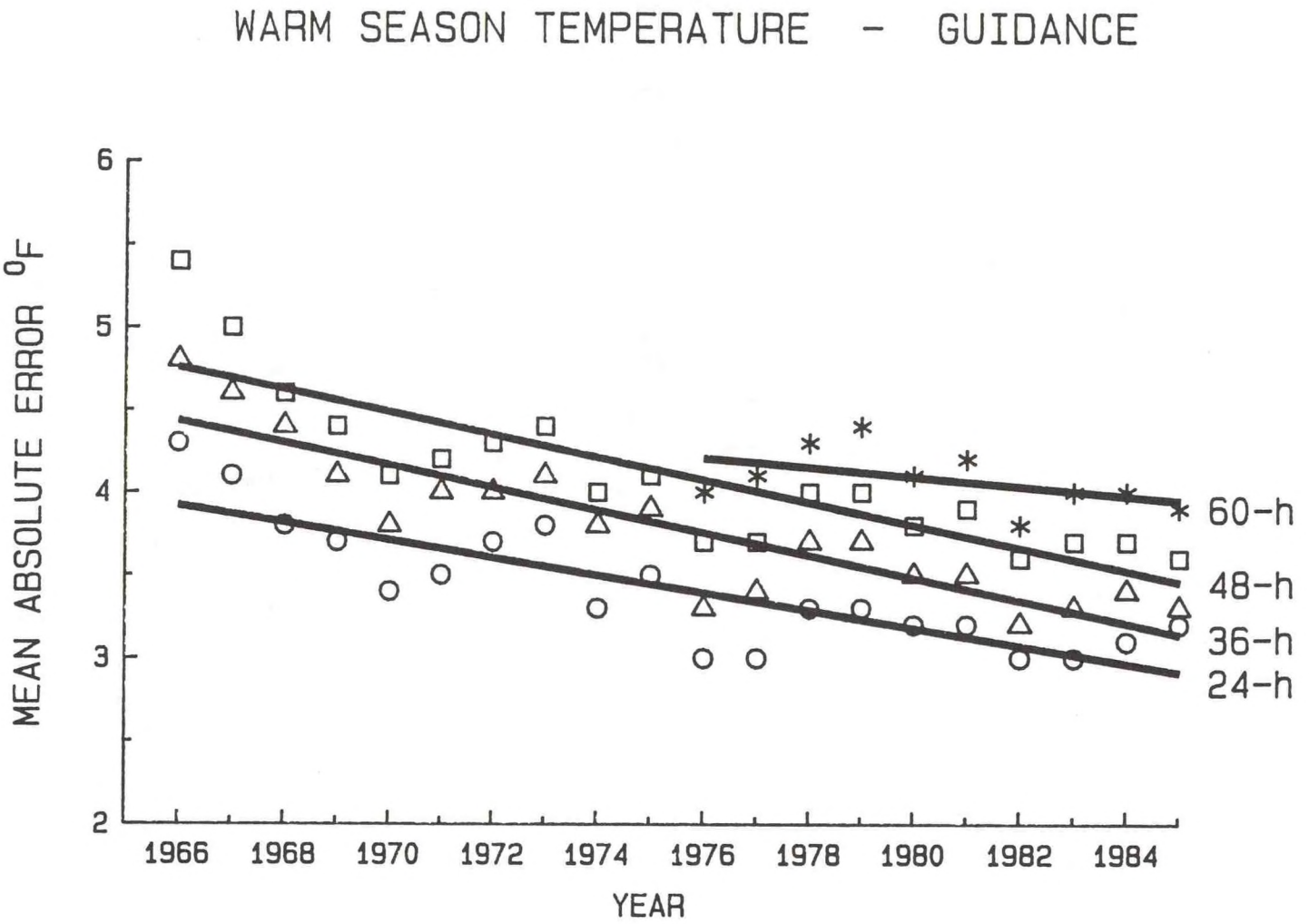

Figure 6. Same as Fig. 5 except for the guidance temperature forecasts.

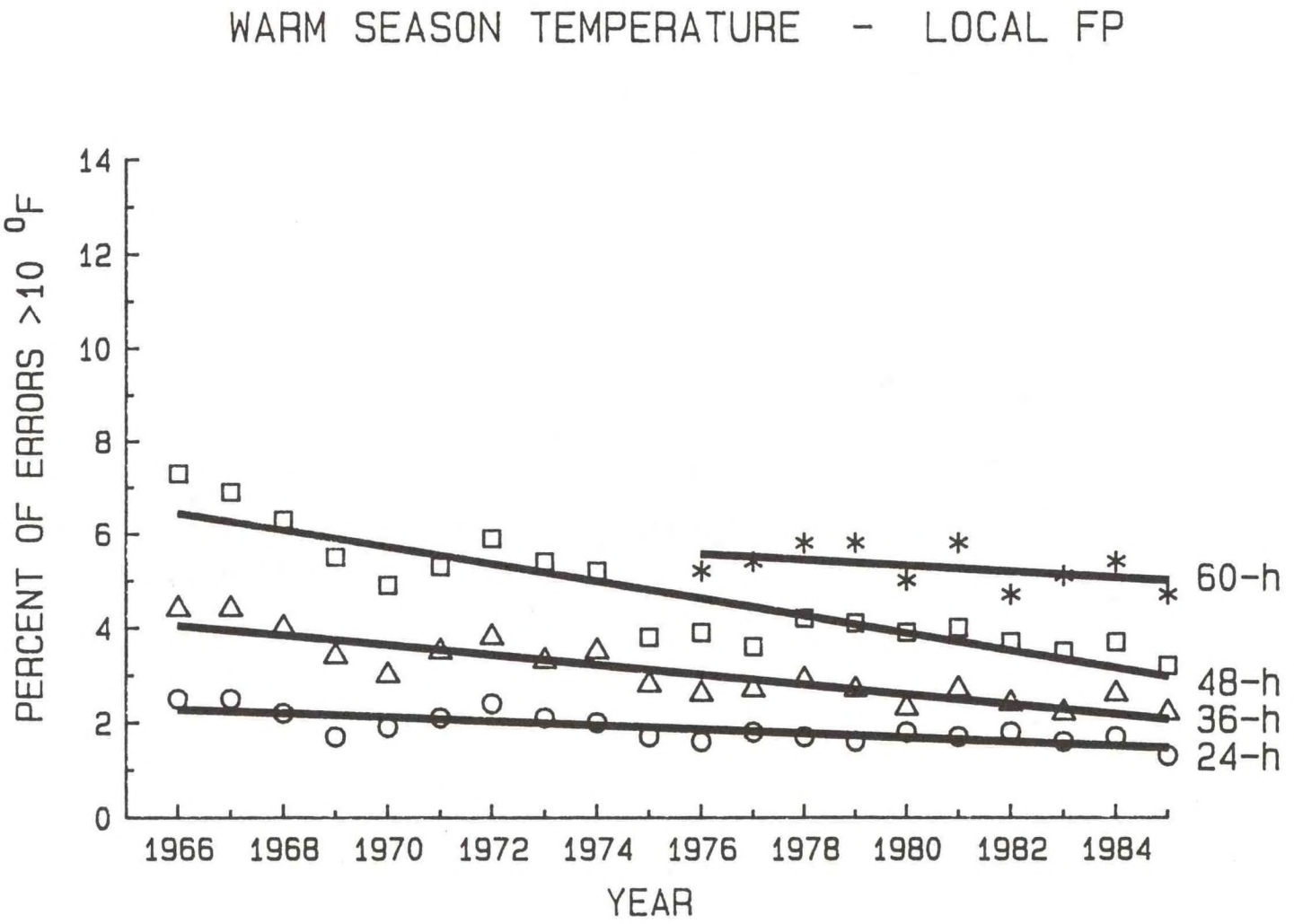

Figure 7. Same as Fig. 5 except for the percentage of errors >10°F.

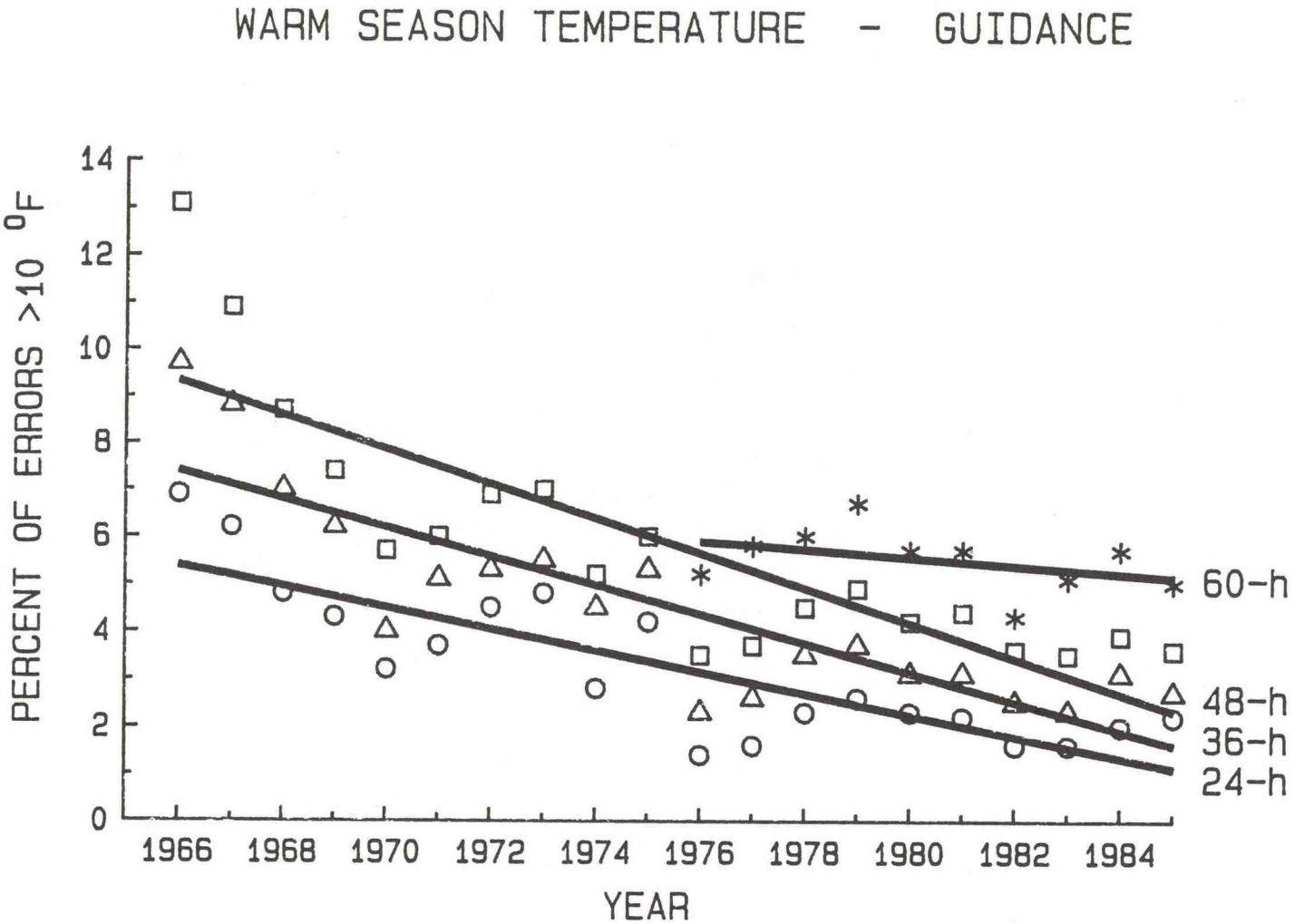

Figure 8. Same as Fig. 5 except for the percentage of errors >10°F for the guidance forecasts.

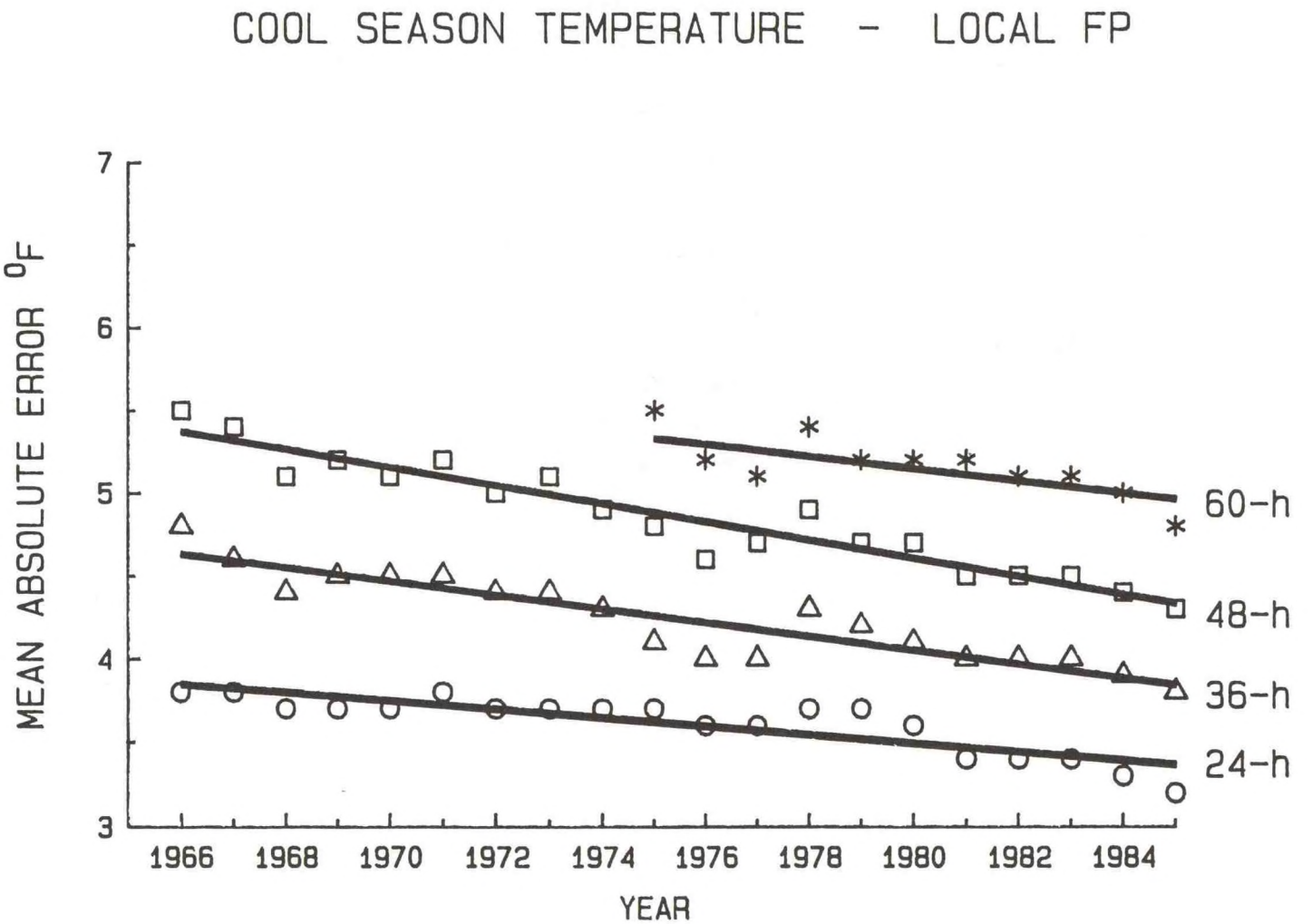

Figure 9. Time series of national mean absolute errors (°F) for the local FP temperature forecasts (maximum and minimum combined) during the cool season.

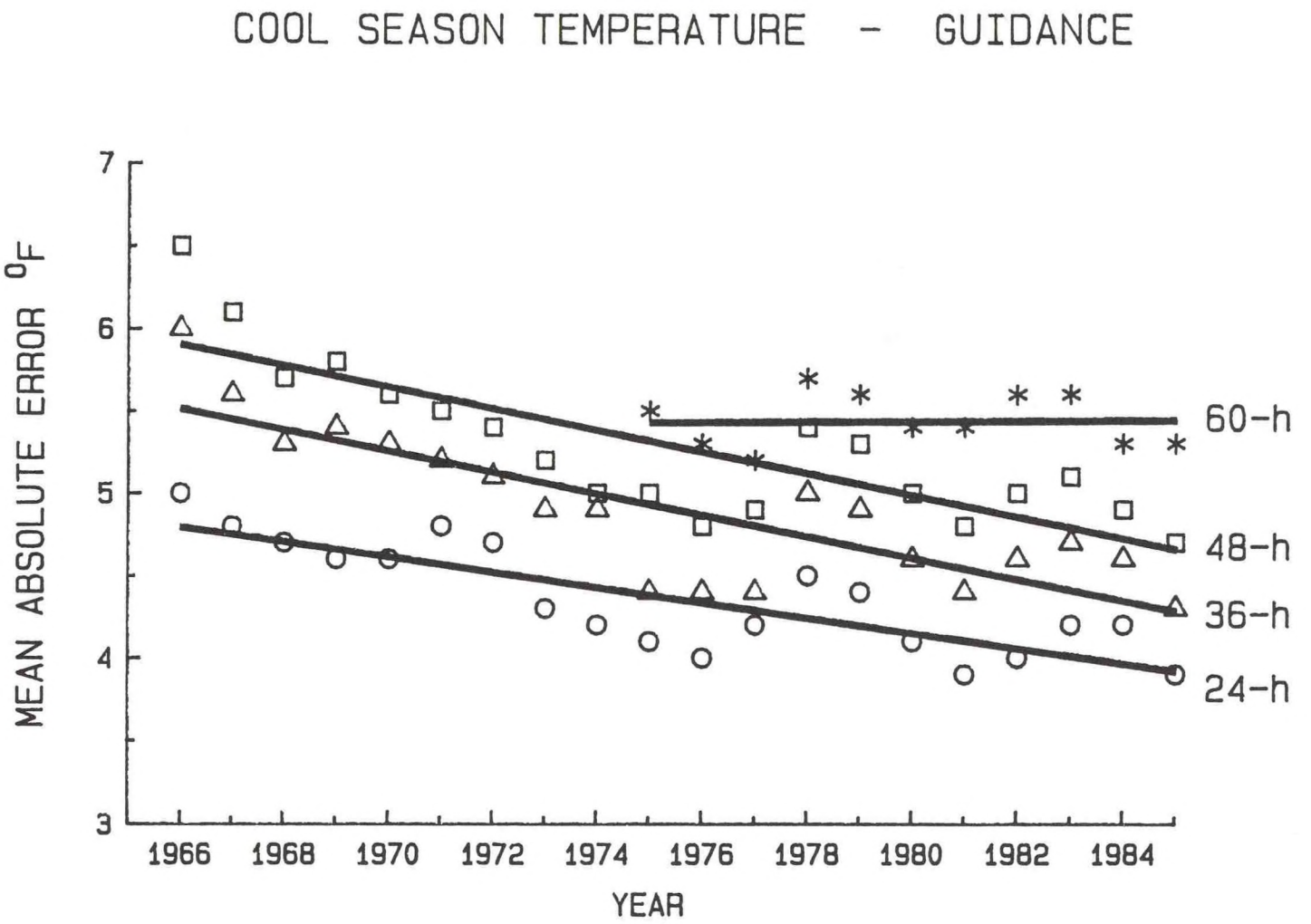

Figure 10. Same as Fig. 9 except for the guidance temperature forecasts.

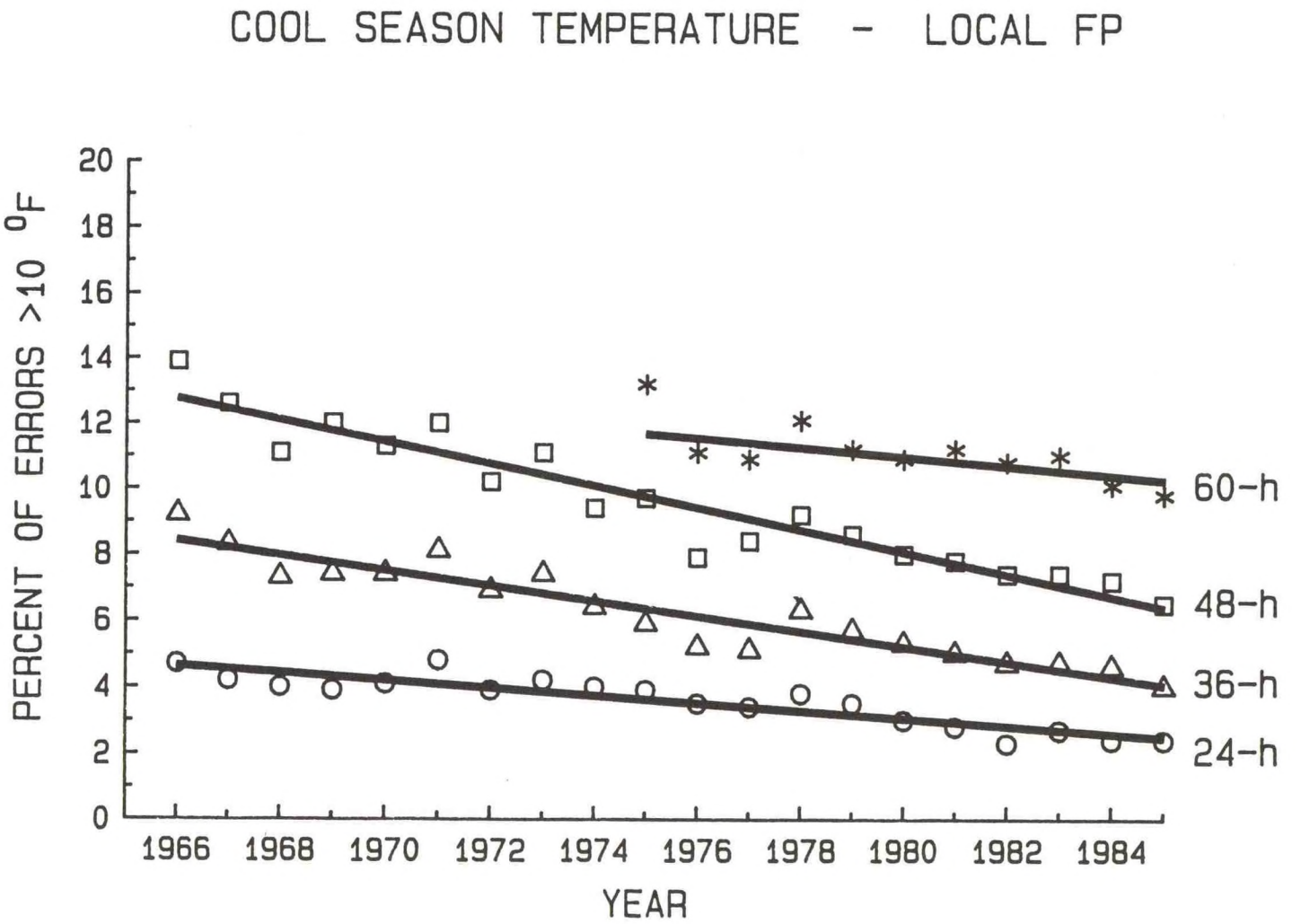

Figure 11. Same as Fig. 9 except for the percentage of errors >10°F.

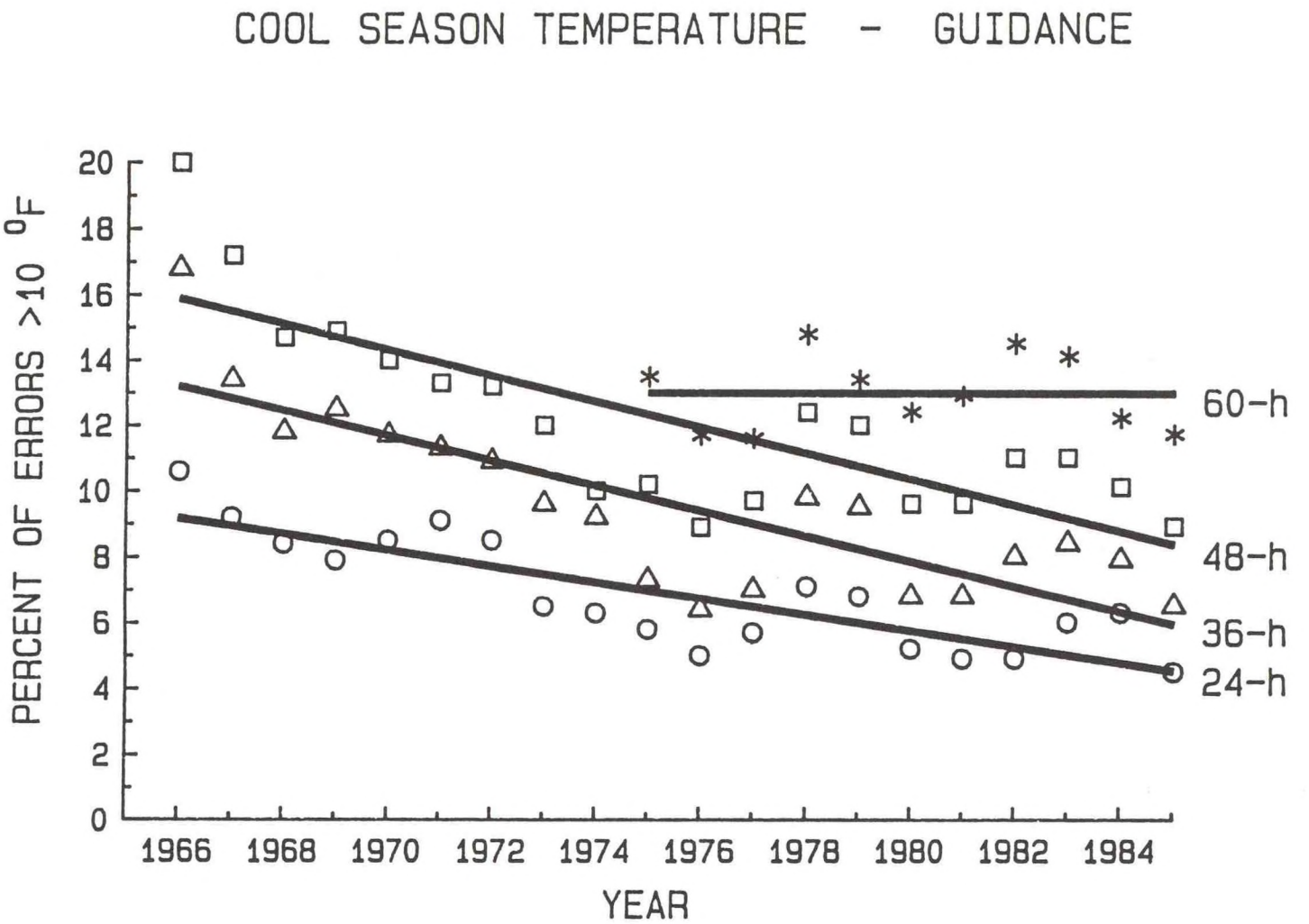

Figure 12. Same as Fig. 9 except for the percentage of errors >10°F for the guidance forecasts.

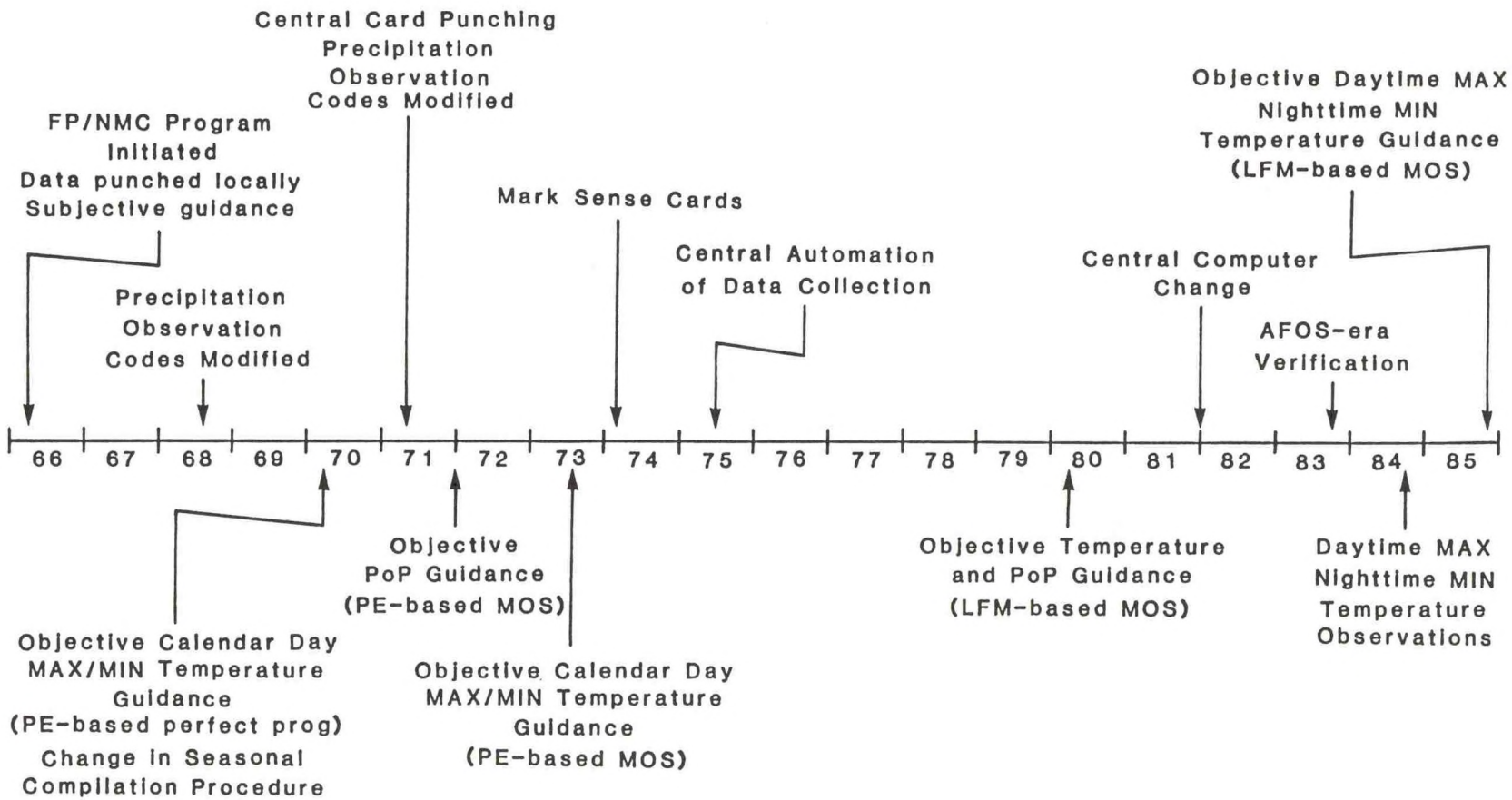

Figure 13. Important changes in the FP/NMC verification program.

A. - One or more "pseudo files" of data each consisting of:

1 - Header information, consisting of:

Record 1 - Format (A4,9I4):

Word 1 - 4 characters = "NWSV" used to identify NWSVER tape.
Word 2 - Number of stations in this pseudo file = NSTA.
Word 3 - Record size = NWDS = NSTA + 4.
Words 4-10 - Zero (not used currently).

Record 2 - Format(104I6):

Word 1 - Zero (not used currently).
Word 2 - Record ID = 1.
Word 3 - Zero (not used currently).
Word 4 - Zero (not used currently).
Word 5-NWDS - NSTA station WBAN numbers in numerical order.

Record 3 - Format (4I4,100A4):

Word 1 - Zero (not used currently).
Word 2 - Record ID = 2.
Word 3 - Zero (not used currently).
Word 4 - Zero (not used currently).
Words 5-NWDS - NSTA station call letters, left justified, in same order as in header record 2.

2 - Multiple records - Format (4I9,100F9.3):

Word 1 - Record date in format YR*1000000 + MO*10000 =DA*100 + HR, where HR is the GMT forecast cycle either 00 or 12. (Integer*4)

Word 2 - Data ID (see Table 13). (Integer*4)

Word 3 - Data category (see Table 13). (Integer*4)

Word 4 - Data tau (projection). (Integer*4)

Words 5-NWDS - Data for stations in order specified in header records 2 and 3. (Real*4)

3 - A dummy record - Format (104I9):

Words 1-NWDS - set = 9999.

B - End of data on tape signaled by an EOF.

Figure 14. Format of the FP/NMC verification data archive.

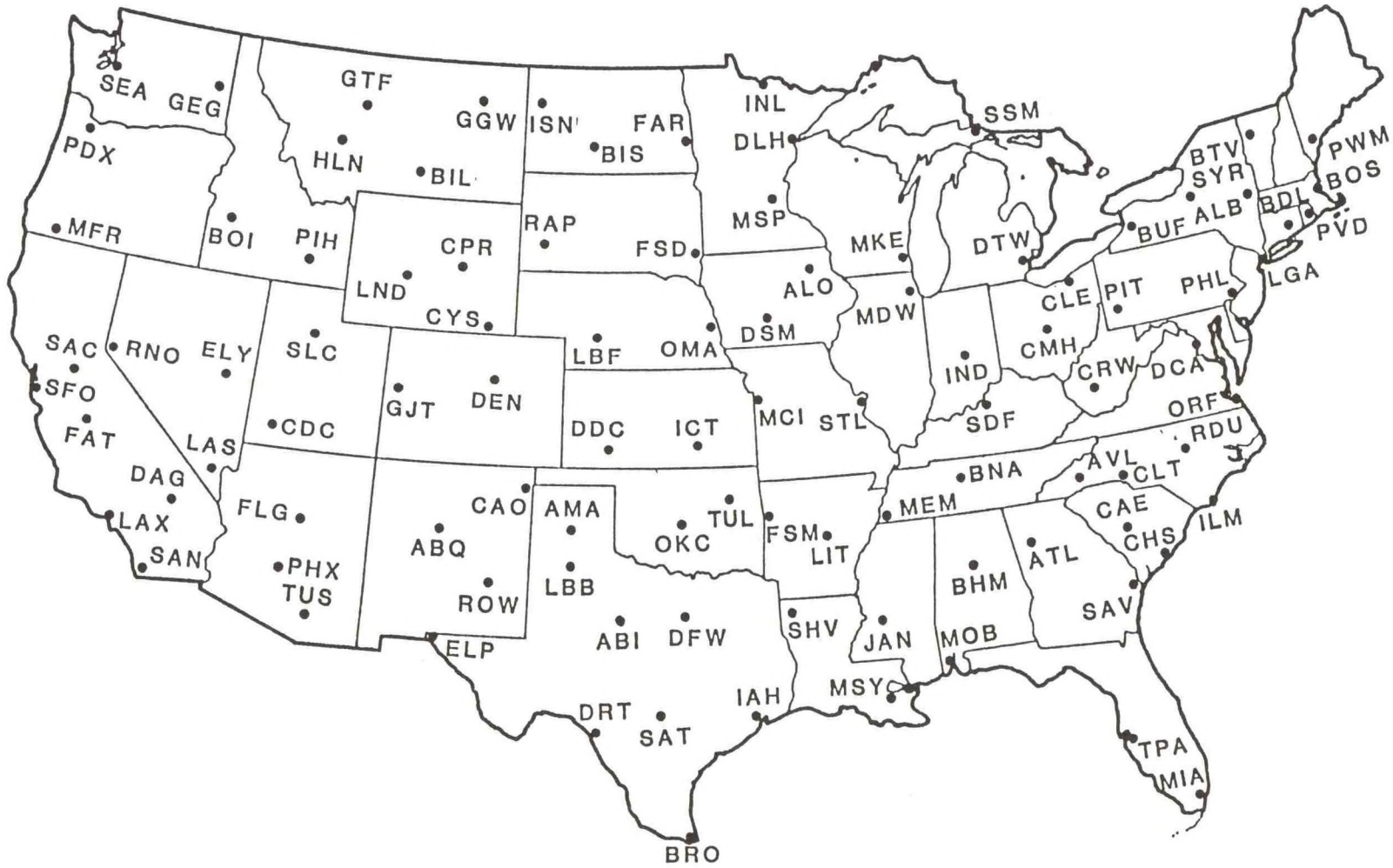

Figure 15. The 100 forecast sites which comprise the FP/NMC verification archive network.

(Continued from inside front cover)

NOAA Technical Memorandums

NWS FCST 16 Weather Bureau April 1969 to March 1970 Verification Report With Special Emphasis on Performance Scores within Echelons. Robert G. Derouin and Geraldine F. Cobb, April 1971. (COM-71-00555)

NWS FCST 17 National Weather Service May 1970 to April 1971 Public Forecast Verification Summary. Robert G. Derouin and Geraldine F. Cobb, March 1972. (COM-72-10484)

NWS FCST 18 Long-Term Verification Trends of Forecasts by the National Weather Service. Duane S. Cooley and Robert G. Derouin, May 1972. (COM-72-11114)

NWS FCST 19 National Weather Service May 1971 to April 1972 Public Forecast Verification Summary. Alexander F. Sadowski and Geraldine F. Cobb, July 1973. (COM-73-11-55 7/AS)

NWS FCST 20 National Weather Service Heavy Snow Forecast Verification 1962 to 1972. Alexander F. Sadowski and Geraldine F. Cobb, January 1974. (COM-74-10518)

NWS FCST 21 National Weather Service April 1972 to March 1973 Public Forecast Verification Summary. Alexander F. Sadowski and Geraldine F. Cobb, June 1974. (COM-74-1 1467/AS)

NWS FCST 22 Photochemical (Oxidant) Air Pollution Summary Information. Stephen W. Harned and Thomas Laufer, December 1977. (PB-283868/AS)

NWS FCST 23 Low-Level Wind Shear: A Critical Review. Julius Badner, April 1979, 72 pp. (PB-300715)

NWS FCST 24 Probability Forecasting--Reasons, Procedures, Problems. Lawrence A. Hughes, January 1980, 89 pp. (PB80-164353)

NWS FCST 25 National Weather Service Public Forecast Verification Summary--April 1973 to March 1978. Duane S. Cooley, Frederick S. Zbar, Dean F. Dubofsky, and A. Kristine Campbell, March 1981, 136 pp. (PB81-231714)

NWS FCST 26 National Weather Service 1980 Watch/Warning Verification: Flash Flood, Winter Storm and High Wind. A. Kristine Campbell, August 1981, 36 pp. (PB82-148719)

NWS FCST 27 National Weather Service 1981 Watch/Warning Verification: Flash Flood, Winter Storm and High Wind. A. Kristine Campbell, July 1982. (PB83-118018)

NWS FCST 28 National Weather Service Public Forecast Verification Summary, April 1978 to March 1982. Paul D. Polger, April 1983. (PB83-232173)

NWS FCST 29 Public Response to Hurricane Probability Forecasts. Jay Baker, January 1984. (PB84-158658)

NWS FCST 30 1982 and 1983 Watch/Warning Verification: Flash Flood, Winter Storm and High Wind. A. Kristine Campbell, January 1985. (PB85-20-1899)

NOAA SCIENTIFIC AND TECHNICAL PUBLICATIONS

The National Oceanic and Atmospheric Administration was established as part of the Department of Commerce on October 3, 1970. The mission responsibilities of NOAA are to assess the socioeconomic impact of natural and technological changes in the environment and to monitor and predict the state of the solid Earth, the oceans and their living resources, the atmosphere, and the space environment of the Earth.

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PROFESSIONAL PAPERS-Important definitive research results, major techniques, and special investigations.

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ATLAS-Presentation of analyzed data generally in the form of maps showing distribution of rainfall, chemical and physical conditions of oceans and atmosphere, distribution of fishes and marine mammals, ionospheric conditions, etc.

TECHNICAL SERVICE PUBLICATIONS-Reports containing data, observations, instructions, etc. A partial listing includes data serials; prediction and outlook periodicals; technical manuals, training papers, planning reports, and information serials; and miscellaneous technical publications.

TECHNICAL REPORTS-Journal quality with extensive details, mathematical developments, or data listings.

TECHNICAL MEMORANDUMS-Reports of preliminary, partial, or negative research or technology results, interim instructions, and the like.