NOAA TM NWS ER-48

NOAA Technical Memorandum NWS ER-48

U. S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Weather Service

ACCURACY OF AUTOMATED TEMPERATURE FORECASTS FOR PHILADELPHIA AS RELATED TO SKY CONDITION AND WIND DIRECTION

Robert B. Wassall

Eastern Region
Garden City, NY
September 1972

NOAA TECHNICAL MEMORANDA
National Weather Service, Eastern Region Subseries

The National Weather Service Eastern Region (ER) Subseries provides an informal medium for the documentation and quick dissemination of results not appropriate, or not yet ready, for formal publication. The series is used to report on work in progress, to describe technical procedures and practices, or to relate progress to a limited audience. These Technical Memoranda will report on investigations devoted primarily to regional and local problems of interest mainly to ER personnel, and hence will not be widely distributed.

Papers 1 to 22 are in the former series, ESSA Technical Memoranda, Eastern Region Technical Memoranda (ERTM); papers 23 to 37 are in the former series, ESSA Technical Memoranda, Weather Bureau Technical Memoranda (WBTM). Beginning with 38, the papers are now part of the series, NOAA Technical Memoranda NWS.

Papers 1 to 22 are available from the National Weather Service Eastern Region, Scientific Services Division, 585 Stewart Avenue, Garden City, N.Y. 11530. Beginning with 23, the papers are available from the National Technical Information Service, U.S. Department of Commerce, Sills Bldg., 5285 Port Royal Road, Springfield, Va. 22151. Price: $3.00 paper copy; $0.95 microfilm. Order by accession number shown in parentheses at end of each entry.

ESSA Technical Memoranda

ERTM 1 Local Uses of Vorticity Prognoses in Weather Prediction. Carlos R. Dunn. April 1965

ERTM 2 Application of the Barotropic Vorticity Prognostic Field to the Surface Forecast Problem. Silvio G. Simplicio. July 1965

ERTM 3 A Technique for Deriving an Objective Precipitation Forecast Scheme for Columbus, Ohio. Robert Kuessner. September 1965

ERTM 4 Stepwise Procedures for Developing Objective Aids for Forecasting the Probability of Precipitation. Carlos R. Dunn. November 1965

ERTM 5 A Comparative Verification of 300 mb. Winds and Temperatures Based on NMC Computer Products Before and After Manual Processing. Silvio G. Simplicio. March 1966

ERTM 6 Evaluation of OFDEV Technical Note No. 17. Richard M. DeAngelis. March 1966

ERTM 7 Verification of Probability Forecasts at Hartford, Connecticut, for the Period 1963-1965. Robert B. Wassall. March 1966

ERTM 8 Forest-Fire Pollution Episode in West Virginia November 8-12, 1964. Robert O. Weedfall. April 1966

ERTM 9 The Utilization of Radar in Meso-Scale Synoptic Analysis and Forecasting. Jerry D. Hill. March 1966

ERTM 10 Preliminary Evaluation of Probability of Precipitation Experiment. Carlos R. Dunn. May 1966

ERTM 11 Final Report. A Comparative Verification of 300 mb. Winds and Temperatures Based on NMC Computer Products Before and After Manual Processing. Silvio G. Simplicio. May 1966

ERTM 12 Summary of Scientific Services Division Development Work in Sub-Synoptic Scale Analysis and Prediction - Fiscal Year 1966. Fred L. Zuckerberg. July 1966

ERTM 13 A Survey of the Role of Non-Adiabatic Heating and Cooling in Relation to the Development of Mid-Latitude Synoptic Systems. Constantine Zois. July 1966

ERTM 14 The Forecasting of Extratropical Onshore Gales at the Virginia Capes. Glen V. Sachse. August 1966

ERTM 15 Solar Radiation and Clover Temperature. Alex J. Kish. September 1966

ERTM 16 The Effects of Dams, Reservoirs and Levees on River Forecasting. Richard M. Greening. September 1966

ERTM 17 Use of Reflectivity Measurements and Reflectivity Profiles for Determining Severe Storms. Robert E. Hamilton. October 1966

ERTM 18 Procedure for Developing a Nomograph for Use in Forecasting Phenological Events from Growing Degree Days. John C. Purvis and Milton Brown. December 1966

ERTM 19 Snowfall Statistics for Williamsport, Pa. Jack Hummel. January 1967

ERTM 20 Forecasting Maturity Date of Snap Beans in South Carolina. Alex J. Kish. March 1967

ERTM 21 New England Coastal Fog. Richard Fay. April 1967

ERTM 22 Rainfall Probability at Five Stations Near Pickens, South Carolina, 1957-1963. John C. Purvis. April 1967

WBTM ER 23 A Study of the Effect of Sea Surface Temperature on the Areal Distribution of Radar Detected Precipitation Over the South Carolina Coastal Waters. Edward Paquet. June 1967 (PB-180-612)

WBTM ER 24 An Example of Radar as a Tool in Forecasting Tidal Flooding. Edward P. Johnson. August 1967 (PB-180-613)

WBTM ER 25 Average Mixing Depths and Transport Wind Speeds over Eastern United States in 1965. Marvin E. Miller. August 1967 (PB-180-614)

WBTM ER 26 The Sleet Bright Band. Donald Marier. October 1967 (PB-180-615)

WBTM ER 27 A Study of Areas of Maximum Echo Tops in the Washington, D.C. Area During the Spring and Fall Months. Marie D. Fellechner. April 1968 (PB-179-339)

WBTM ER 28 Washington Metropolitan Area Precipitation and Temperature Patterns. C. A. Woollum and N. L. Canfield. June 1968 (PB-179-340)

WBTM ER 29 Climatological Regime of Rainfall Associated with Hurricanes after Landfall. Robert W. Schoner. June 1968 (PB-179-341)

WBTM ER 30 Monthly Precipitation - Amount Probabilities for Selected Stations in Virginia. M. H. Bailey. June 1968 (PB-179-342)

WBTM ER 31 A Study of the Areal Distribution of Radar Detected Precipitation at Charleston, S. C. S. K. Parrish and M. A. Lopez. October 1968 (PB-180-480)

WBTM ER 32 The Meteorological and Hydrological Aspects of the May 1968 New Jersey Floods. Albert S. Kachic and William Long. February 1969 (Revised July 1970) (PB-194-222)

WBTM ER 33 A Climatology of Weather that Affects Prescribed Burning Operations at Columbia, South Carolina. S. E. Wasserman and J. D. Kanupp. December 1968 (COM-71-00194)

WBTM ER 34 A Review of Use of Radar in Detection of Tornadoes and Hail. R. E. Hamilton. December 1969 (PB-188-315)

WBTM ER 35 Objective Forecasts of Precipitation Using PE Model Output. Stanley E. Wasserman. July 1970 (PB-193-378)

WBTM ER 36 Summary of Radar Echoes in 1967 Near Buffalo, N.Y. Richard K. Sheffield. September 1970 (COM-71-00310)

WBTM ER 37 Objective Mesoscale Temperature Forecasts. Joseph P. Sobel. September 1970 (COM-71-0074)

NOAA Technical Memoranda NWS

NWS ER 38 Use of Primitive Equation Model Output to Forecast Winter Precipitation in the Northeast Coastal Sections of the United States. Stanley E. Wasserman and Harvey Rosenblum. December 1970 (COM-71-00138)

NWS ER 39 A Preliminary Climatology of Air Quality in Ohio. Marvin E. Miller. January 1971 (COM-71-00204)

(Continued On Inside Rear Cover)

UNITED STATES DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL WEATHER SERVICE EASTERN REGION
Garden City, New York

NOAA TECHNICAL MEMORANDUM NWS ER-48

ACCURACY OF AUTOMATED TEMPERATURE FORECASTS FOR PHILADELPHIA AS RELATED TO SKY CONDITION AND WIND DIRECTION

Robert B. Wassall
National Weather Service Forecast Office, NOAA
Philadelphia, Pennsylvania

SCIENTIFIC SERVICES DIVISION
Eastern Region Headquarters
September 1972

ACCURACY OF AUTOMATED TEMPERATURE
FORECASTS FOR PHILADELPHIA AS RELATED
TO SKY CONDITION AND WIND DIRECTION

Abstract

Mean absolute and algebraic errors for National Weather Service automated surface temperature forecasts for Philadephia, PA, are presented as a function of observed cloud cover and surface wind direction. Application of results on independent data, using operational forecasts of cloud cover and wind direction, decreased the error in automated temperature forecasts by an average of 1.0° F. for minimum temperature and 0.1° F. for maximum temperature.

I. Introduction

Objective temperature forecasts (Klein), prepared by computer, are issued twice daily for a large number of cities in the United States, one of which is Philadelphia, PA. Each forecast release contains 2 predicted daily maximum temperature and 2 predicted daily minimum temperatures for a period 24 to 60 hours in advance of initial data time. The forecasts based on 0000Z data, for instance, are for subsequent daily maximum, minimum, maximum and minimum temperatures in that order.

The automated forecasts are based on large-scale upper air conditions predicted by the primitive equation (PE) model and on antecedent temperature conditions. Different sets of multiple regression equations are used for each bimonthly period starting with January-February. The regression equations usually contain four or five variables consisting of 700 mb. heights and 1,000 - 700 mb. thickness values at certain intersections of latitude and longitude and maximum and minimum temperatures at certain key cities. The day of the year also appears in some equations. For the dependant data, the equations derived for Philadelphia give an average reduction of variance of about 77% and a standard error of estimate of about 4.4 degrees.

Since the computer forecasts are based on correlations between surface daily maximum and minimum temperatures and large-scale upper air conditions, specific localized conditions that may affect temperatures are accounted for only in an indirect manner. It is assumed that the local forecaster will make adjustments to the computer predictions when local conditions are considered important or abnormal. It is the purpose of this investigation to relate errors in the computer forecasts to observed conditions of sky cover and surface wind direction. A set of corrections are presented which can be used by the local forecaster in modifying the automated forecasts.

II. Procedures

Automated temperature forecasts were examined for the one year period from April 1970 through March 1971. The April 1970 starting date was selected because of a modification in the operational system during March 1970 which subsequently allowed for input from the NMC PE model. No known significant changes have been made in the operational system since March 1970.

Observed conditions of opaque sky cover and wind direction were averaged for 12-hour periods from 0000Z to 1200Z and from 1200Z to 0000Z to correspond with the usual periods of falling and rising temperatures, respectively. Sky condition was categorized as being clear, partly cloudy, or cloudy, based on the usual definition of these terms, i.e., 0-3, 4-7, and 8-10 tenths of cloudiness, respectively. Average 12-hourly wind direction to eight points of the compass was estimated by visual examination of the hourly observations in the 12-hour period.

Although the normal time of occurrence of daily temperature extremes varies with the time of year, no attempt was made to use a variable time period in which to average cloud cover and wind direction. It was assumed that sky cover and/or wind direction observations between the time of occurrence of the maximum or minimum temperature and the end of a 12-hour period would not significantly affect the average for the 12-hour period. It was therefore considered appropriate to work with the fixed 12-hour periods as stated above.

Mean absolute and algebraic errors for the automated forecasts were determined for each category of sky cover and wind direction, seperately and in combination, to determine if a bias existed. These statistics were determined for bimonthly periods conforming with the use of bimonthly regression equations.

Finally, a set of algebraic corrections was derived based on the above calculations. Corrections applied to the automated temperature forecasts on an operational basis by forecasters at Philadelphia from July 1, 1971 to December 31, 1971 were evaluated to determine usefulness of these corrections.

III. Discussion of Results

The average errors in automated temperature forecasts for different lead times of forecasts are depicted in *Table 1*. On an annual basis, average absolute errors ranged from 4.0 degrees to 4.7 degrees for maximum temperatures and 3.6 to 4.4 degrees for minimum temperatures. The increase in mean absolute forecast error from the first period to the fourth period was nearly identical for maximum and minimum temperature forecasts averaging 0.7 and 0.8 degrees, respectively. This represents only an 18% increase in error as the forecast period was extended from 24 to 60 hours.

Absolute errors in maximum temperatures were largest during January-February, March-April, and May-June, while absolute errors in minimum temperatures were largest in the September-October, November-December, and January-February periods. The largest average error for any period was 6.2 degrees in minima during September-October. It might be well to mention, however, that the data for that two-month period may have been influenced by abnormally high temperatures during much of September. This fact should be kept in mind when future references are made to that particular bimonthly period.

The smallest absolute errors occurred in first period maxima and second period minima forecasts for July-August, the average being 2.3 degrees. The average error of all forecasts issued in the July-August period was only 2.7 degrees.

Mean algebraic errors, on an annual basis, averaged +0.2 to +0.9 for maximum temperatures and -1.9 to -2.5 for minimum temperature forecasts. All maxima predictions were too high, on the average, except those recorded during the questionable September-October period and also the second period forecasts in March-April. The largest algebraic error involving maxima, +2.3 degrees, occurred in fourth period January-February forecasts and first period May-June forecasts. Minimum temperatures, on the other hand, were too low in every period and the largest algebraic error was -4.4 degrees for fourth period September-October forecasts.

In *Table 2*, temperature forecast errors for all periods combined are shown as a function of sky cover conditions. It can be seen that the largest mean absolute errors for both maxima and minima occurred under cloudy conditions. Maxima on cloudy days during May-June were on the average 7.1 degrees in error and those during March-April were 6.4 degrees in error. Minimum temperatures during September-October were 7.0 degrees in error, on the average, on cloudy nights. On an annual basis there was little difference between the average errors on clear and partly cloudy days.

The effects of sky cover becomes even more apparent when considering the mean algebraic errors. Maximum temperature forecasts averaged 1.4 degrees too low on clear days but were 2.7 degrees too high on cloudy days, an algebraic difference of 4.1 degrees. Minimum temperature forecasts were 0.5 degrees too low on clear nights and 4.2 degrees too low on cloudy nights, a difference of 3.7 degrees. Considering individual two-month periods, the effects of sky condition become even more pronounced. In May-June, maxima forecasts on clear days averaged 2.4 degrees too low but were 6.5 degrees too high on cloudy days, an algebraic difference of 8.9 degrees. In March-April the difference was 8.0 degrees. Minimum temperature forecasts in November-December averaged 1.6 degrees too high on clear nights and 6.1 degrees too low on cloudy nights, an algebraic difference of 7.7 degrees. In contrast to these large differences, there was less than one degree algebraic difference between clear and cloudy conditions for November-December maxima and July-August minima.

Tables 3 and *4* relate temperature forecast errors to wind direction for all periods combined. First, considering maximum temperatures *(Table 3)*, it can be seen that the largest errors, both absolute and algebraic, occurred with northeast winds. On an annual basis, all algebraic errors were on the plus side except for those associated with southwest winds which averaged 2.4 degrees too low and north winds which averaged 1.6 degrees too low. The latter, although unexpected, might be explained by the fact that northerly winds have a trajectory across the Philadelphia heat island before reaching the airport observational point.

Minimum temperature forecasts *(Table 4)*, on an annual basis, were too low for every direction except northwest winds for which the mean algebraic error was +0.7 degrees. The largest mean absolute and algebraic errors were for easterly winds. For all wind directions from northeast through southeast to southwest there were sizable mean absolute errors. Algebraic errors for those directions ranged from -2.9 to -4.7 degrees.

For both maximum and minimum temperature predictions there were algebraic differences of greater than 10 degrees between mean algebraic errors for certain pairs of wind directions. During September-October, for instance, minima averaged 2.3 degrees too high when winds were northerly and 9.9 degrees too low with southerly winds, a difference of 12.2 degrees.

Considering both sky conditions (clear, partly cloudy, and cloudy) and wind direction (eight compass headings plus variable) together, mean algebraic errors were computed for each of 27 possible combinations for both maxima and minima for each bimonthly period. (Because of the relatively small number of occurrences in most categories, it was not practical to further refine the data to account for possible degradation with forecast period.) In *Tables 5* through *7*, the signs of mean algebraic error were reversed so as to produce a set of corrections that could be applied directly to the automated predictions. Corrections were computed only for those categories where eight or more cases could be averaged. Where less than eight cases were available in a two-month period, the corrections, shown in parentheses, were based on annual rather than bimonthly data for the particular sky condition - wind direction combination. Where at least eight cases were not available for the entire year for a particular combination, no correction was indicated.

IV. Operational Evaluation

The objectively-derived corrections are being applied to the automated temperature forecasts on a routine basis by forecasters at WSFO Philadelphia. Operational use requires subjective determination of the expected cloud cover and wind direction during the forecast periods of interest. The resultant forecast temperatures are used as a guide in the preparation of the official Philadelphia and vicinity forecast (FP). To evaluate the usefulness of the corrected automated temperatures as a forecast tool, these forecasts were compared with the original automated forecasts and with the FP forecasts for the period from July 1 through December 31, 1971. Only those days when the automated forecasts were received are included in the evaluation. The results are summarized in *Tables 8* and *9*.

The objective corrections were much more effective for minimum temperature forecasts than for maximum temperature forecasts. The average improvement over the original automated forecast *(Table 8)* was 1.0 degrees for minima and 0.1 degrees for maxima. In two months, October and December, the corrected maxima were, on the average, in greater error than the original forecasts. On the other hand, in August and November, the corrected maxima were slightly superior to the FP forecasts. In every month, the average minimum temperature error was lessened by application of the objective corrections. No attempt will be made to explain the difference in the effectiveness of the maxima and minima corrections other than to suggest that the results may have been a reflection of the prevailing weather regime during the period of evaluation or the difficulty in forecasting clouds and wind direction in the daytime as compared to nighttime.

The FP was superior to the automated and the objectively-adjusted automated forecasts in all but the two periods mentioned above. Considering all forecasts combined, the adjusted forecasts improved upon the unadjusted by an average of 0.6 degrees and the FP improved upon the adjusted forecasts by 0.6 degrees. As indicated in *Table 9*, only a third of the automated forecasts were worsened by the application of the corrections while two-thirds remained unchanged or were improved.

V. Conclusions

Mean absolute and algebraic errors for automated temperature forecasts for Philadelphia, PA, have been presented as a function of observed cloud cover and wind direction. It would appear that objectively correcting the automated temperature forecasts, based on subjective wind and cloud forecasts and the results presented here, provided useful input into the preparation of temperature forecasts for Philadelphia and vicinity during the independent data period of July through December 1971. Although the FP forecasts remained superior to the adjusted automated forecasts, it must be remembered that the forecaster did have benefit of this guidance before making his forecast. There is no way of estimating the influence of the adjusted forecasts on the forecasts ultimately issued, but it would seem safe to suggest that the contribution was positive.

The value of an objective technique of this type is, of course, dependent on the ability of the forecaster to make predictions of sky cover and wind direction. The greater the ability to predict these parameters, the more effective the objective corrections presumably would be.

This study could undoubtedly be strengthened with the addition of more input data. However, the tedium of manually deriving, recording and evaluating the data is an obvious deterrent. If computer time were available for studies of this type, it might prove useful to add to this study and/or to develop similar corrections for other locations.

VI. Acknowledgement

Appreciation is expressed to those members of the National Weather Service Forecast Office at Philadelphia who assisted with the collection of data and helped make this investigation possible.

References

Klein, William H., Lewis, Frank, and Caseley, George P., "Computer Forecasts of Maximum and Minimum Surface Temperatures," *WBTM TDL 26*, October, 1969.

Klein, William H., Lewis, Frank, and Hammons, G. A., "Recent Developments in Automated MAX/MIN Temperature Forecasting," *Journal of Applied Meteorology*, October, 1971.

Table 1

Average Temperature Forecast Error by Forecast Period

		Period 1			Period 2			Period 3			Period 4		
		No. Fcsts	Ave. Absolute Error	Ave. Algebraic Error	No. Fcsts	Ave. Absolute Error	Ave. Algebraic Error	No. Fcsts	Ave. Absolute Error	Ave. Algebraic Error	No. Fcsts	Ave. Absolute Error	Ave. Algebraic Error
MAXIMUM TEMPERATURE	Jan-Feb	56	4.9	+1.2	57	4.9	+0.6	56	5.4	+1.1	49	5.2	+2.3
	Mar-Apr	58	4.6	+1.2	57	5.1	-0.1	58	5.2	+0.6	57	5.5	+0.5
	May-Jun	52	4.9	+2.3	53	4.9	+0.9	52	5.1	+0.5	49	5.4	+0.9
	Jul-Aug	57	2.3	+0.5	52	2.8	+0.9	55	2.7	+1.4	50	2.9	+1.3
	Sep-Oct	58	3.9	-1.8	58	4.4	-1.7	57	4.5	-1.0	54	4.8	-0.5
	Nov-Dec	59	3.5	+0.5	56	3.6	+0.5	59	3.8	+0.8	53	4.1	+1.0
	Annual	340	4.0	+0.6	333	4.3	+0.2	337	4.4	+0.6	312	4.7	+0.9
MINIMUM TEMPERATURE	Jan-Feb	57	3.4	-1.8	56	4.1	-1.7	55	4.1	-1.3	54	4.8	-1.3
	Mar-Apr	56	3.3	-1.8	58	3.4	-2.1	57	3.8	-2.5	58	3.9	-2.2
	May-Jun	53	2.9	-0.5	52	3.0	-0.7	54	3.0	-0.9	51	3.3	-1.9
	Jul-Aug	52	2.4	-0.9	57	2.3	-1.0	52	2.9	-1.7	56	3.2	-1.5
	Sep-Oct	58	5.1	-3.8	58	5.9	-4.2	58	6.1	-4.2	56	6.2	-4.4
	Nov-Dec	56	4.1	-2.4	59	4.5	-2.9	56	4.5	-2.9	58	4.8	-3.4
	Annual	332	3.6	-1.9	340	3.9	-2.2	332	4.1	-2.3	333	4.4	-2.5

Table 2

Average Temperature Forecast Error By Sky Condition

		Clear			Partly Cloudy			Cloudy		
		No. Fcsts	Ave. Absolute Error	Ave. Algebraic Error	No. Fcsts	Ave. Absolute Error	Ave. Algebraic Error	No. Fcsts	Ave. Absolute Error	Ave. Algebraic Error
MAXIMUM TEMPERATURE	**Jan-Feb**	54	4.1	-0.2	57	5.5	+1.3	107	5.4	+1.7
	Mar-Apr	66	4.6	-3.1	74	4.0	-1.5	90	6.4	+4.9
	May-Jun	63	5.0	-2.4	84	3.6	+0.1	59	7.1	+6.5
	Jul-Aug	71	2.3	0.0	89	2.1	+0.3	54	3.9	+3.5
	Sep-Oct	76	4.6	-3.2	53	5.2	-3.7	98	3.8	+1.5
	Nov-Dec	57	3.5	+1.1	58	3.8	+0.7	112	3.9	+0.4
	Annual	387	4.0	-1.4	415	3.9	-0.3	520	5.0	+2.7
MINIMUM TEMPERATURE	**Jan-Feb**	76	3.3	+0.3	57	4.2	-1.2	89	4.7	-3.4
	Mar-Apr	98	2.8	-1.0	50	4.0	-1.3	81	4.4	-4.1
	May-Jun	83	2.6	0.0	59	3.2	-1.4	68	3.6	-1.9
	Jul-Aug	83	3.3	-1.1	61	1.9	-0.7	73	2.6	-2.0
	Sep-Oct	100	4.8	-1.9	40	5.8	-4.2	90	7.0	-6.5
	Nov-Dec	56	3.5	+1.6	80	3.1	-2.3	93	6.3	-6.1
	Annual	496	3.4	-0.5	347	3.5	-1.7	494	4.9	-4.2

Table 3

Average Maximum Temperature Forecast Error by Wind Direction

	North			Northeast			East		
	# Fcsts	Ave. Ab. Error	Ave. Al. Error	# Fcsts	Ave. Ab. Error	Ave. Al. Error	# Fcsts	Ave. Ab. Error	Ave. Al. Error
Jan-Feb	0	----	----	36	4.8	+4.4	4	7.0	-7.0
Mar-Apr	8	4.9	-4.9	30	6.4	+6.4	22	6.6	+5.2
May-Jun	4	2.3	+0.8	13	9.1	+8.3	17	7.1	+3.0
Jul-Aug	0	----	----	8	1.1	+0.6	10	2.7	+2.7
Sep-Oct	7	2.4	-1.6	24	5.7	+4.6	27	3.6	+2.4
Nov-Dec	4	2.5	+2.5	44	5.1	+3.0	29	3.5	-2.9
Annual	23	3.3	-1.6	155	5.5	+4.6	109	4.5	+1.2
	Southeast			South			Southwest		
Jan-Feb	16	6.5	-4.3	8	5.3	-0.8	59	4.5	-0.9
Mar-Apr	11	7.0	+4.1	14	5.4	-4.4	50	5.1	-2.3
May-Jun	13	4.5	+4.2	29	4.4	+2.8	74	5.3	-2.4
Jul-Aug	30	4.5	+2.8	32	3.0	+1.2	66	2.1	-0.4
Sep-Oct	29	2.8	-2.2	12	5.3	+2.3	72	6.2	-6.2
Nov-Dec	4	5.3	-5.3	10	4.1	-3.7	41	4.2	-1.0
Annual	103	4.6	+0.3	105	4.3	+0.4	362	4.6	-2.4
	West			Northwest			Variable		
Jan-Feb	49	5.9	+2.3	43	4.4	+3.2	3	6.7	+6.7
Mar-Apr	37	4.2	+1.9	58	4.1	-1.4	0	----	----
May-Jun	15	5.2	-1.2	41	3.8	+3.2	0	----	----
Jul-Aug	30	2.1	+0.3	31	2.8	+2.6	7	1.0	-0.4
Sep-Oct	18	2.4	-1.0	34	3.2	+2.1	4	0.8	-0.8
Nov-Dec	43	4.2	+3.0	42	2.0	+1.3	10	1.4	+1.4
Annual	192	4.2	+1.5	249	3.5	+1.6	24	1.8	+1.2

Table 4

Average Minimum Temperature Forecast Error By Wind Direction

	North			Northeast			East		
	# Fcsts	Ave. Ab. Error	Ave. Al. Error	# Fcsts	Ave. Ab. Error	Ave. Al. Error	# Fcsts	Ave. Ab. Error	Ave. Al. Error
Jan-Feb	20	5.7	-3.0	19	2.8	-1.3	15	3.1	-2.7
Mar-Apr	19	1.5	-0.5	37	4.4	-4.3	30	5.2	-3.7
May-Jun	10	1.6	+0.2	8	2.3	+2.3	16	3.3	-0.4
Jul-Aug	10	3.1	-3.1	16	1.9	-1.9	7	2.3	-1.1
Sep-Oct	7	2.6	+2.3	48	5.6	-2.6	19	7.6	-7.5
Nov-Dec	29	3.6	-1.0	31	4.5	-4.5	22	9.7	-9.0
Annual	95	3.3	-1.2	159	4.3	-2.9	109	5.8	-4.7
	Southeast			South			Southwest		
Jan-Feb	8	2.9	-2.9	8	11.1	-11.1	60	4.9	-1.6
Mar-Apr	18	3.9	-3.3	0	---	----	30	5.1	-2.2
May-Jun	23	4.1	-2.0	49	2.4	-0.5	42	4.6	-4.4
Jul-Aug	20	2.5	-2.3	19	3.0	-2.7	73	2.8	-2.5
Sep-Oct	18	7.6	-7.3	33	9.9	-9.9	38	5.6	-5.6
Nov-Dec	0	---	----	15	4.9	-4.8	33	3.0	-1.5
Annual	87	4.3	-3.5	124	5.4	-4.5	276	4.2	-2.9
	West			Northwest			Variable		
Jan-Feb	57	3.7	-0.1	23	2.4	+0.8	12	1.9	-1.9
Mar-Apr	48	2.9	-1.0	31	2.5	-0.6	16	2.8	-1.1
May-Jun	32	3.1	+0.3	23	1.9	+0.9	7	1.0	-0.1
Jul-Aug	34	2.1	-0.1	19	4.8	+4.8	19	1.6	-0.7
Sep-Oct	18	4.4	-3.6	46	3.2	+0.9	3	1.0	+1.0
Nov-Dec	39	3.4	-0.7	35	3.8	-0.7	25	5.2	-5.0
Annual	228	3.2	-0.6	177	3.1	+0.7	82	2.9	-2.6

Table 5

Objective Corrections to Automated Temperature Forecasts

WIND DIR.	JAN-FEB MAXIMUM TEMPERATURE CLR	PTLY CLDY	CLDY	JAN-FEB MINIMUM TEMPERATURE CLR	PTLY CLDY	CLDY
N	(+3)	----	----	(0)	(0)	+6
NE	(+3)	----	-4	(0)	(+1)	+2
E	(+4)	----	(-2)	(-3)	(+1)	+3
SE	(+1)	(+2)	+4	(-1)	(+5)	+3
S	----	(0)	+1	(+4)	(+3)	(+6)
SW	+1	+3	0	+1	+3	0
W	(0)	-3	+1	-1	0	+7
NW	-2	-2	-6	-3	+1	(+3)
VRBL	----	----	(-2)	+3	(+2)	(+3)

WIND DIR.	MAR-APR CLR	PTLY CLDY	CLDY	MAR-APR CLR	PTLY CLDY	CLDY
N	+5	----	----	0	(0)	(+4)
NE	(+3)	----	-6	(0)	(+1)	+5
E	(+4)	----	-7	(-3)	(+1)	+5
SE	(+1)	(+2)	(-2)	(-1)	(+5)	+4
S	(+2)	(0)	+6	(+4)	(+3)	(+6)
SW	+5	+3	(-1)	+4	+1	(+3)
W	+1	(-2)	-4	+1	(+1)	(+4)
NW	+3	+1	(-5)	+1	0	(+3)
VRBL	----	----	(-2)	(+2)	(+2)	+3

*Corrections in ( ) are based on annual rather than bimonthly data.

---- indicates insufficient data for a bimonthly or annual correction.

Table 6

Objective Corrections to Forecasts

	MAY-JUN					
WIND DIR.	CLR	PTLY CLDY	CLDY	CLR	PTLY CLDY	CLDY
N	(+3)	----	----	(0)	(0)	(+4)
NE	(+3)	----	-8	(0)	(+1)	(+4)
E	(+4)	----	-8	-3	(+1)	+4
SE	(+1)	(+2)	(-2)	(-1)	(+5)	+4
S	(+2)	-4	-4	+1	+1	-1
SW	+3	(+3)	(-1)	+4	+5	(+3)
W	+3	-2	(-2)	-2	(+1)	+2
NW	+1	-3	-6	-1	-2	(+3)
VRBL	----	----	----	(+2)	(+2)	(+3)

	JUL-AUG					
WIND DIR.	CLR	PTLY CLDY	CLDY	CLR	PTLY CLDY	CLDY
N	(+3)	----	----	(0)	(0)	(+4)
NE	(+3)	----	(-5)	(0)	+2	(+4)
E	(+4)	----	(-2)	(-3)	(+1)	(+6)
SE	(+1)	(+2)	-6	(-1)	(+5)	+3
S	----	+2	-3	(+4)	(+3)	+3
SW	+2	0	(-1)	+3	+3	+2
W	+1	-1	(-2)	+1	-2	(+4)
NW	-2	-1	(-5)	-7	-2	(+3)
VRBL	----	----	(-2)	+2	(+2)	(+3)

*Corrections in ( ) are based on annual rather than bimonthly data.

---- indicates insufficient data for a bimonthly or annual correction.

Table 7

Objective Corrections to Forecasts

				SEP-OCT		
WIND DIR.	CLR	PTLY CLDY	CLDY	CLR	PTLY CLDY	CLDY
N	(+3)	----	----	(0)	(0)	(+4)
NE	(+3)	----	-6	-1	-1	+5
E	(+4)	----	-3	(-3)	(+1)	+8
SE	(+1)	(+2)	+2	(-1)	(+5)	+8
S	----	0	-5	+10	(+3)	+10
SW	+7	+8	+3	+5	+6	(+3)
W	+1	(-2)	(-2)	(-1)	(+1)	+4
NW	-2	(-2)	(-5)	-1	(0)	(+3)
VRBL	----	----	(-2)	(+2)	(+2)	----

				NOV-DEC		
WIND DIR.	CLR	PTLY CLDY	CLDY	CLR	PTLY CLDY	CLDY
N	(+3)	----	----	(0)	+2	+2
NE	(+3)	----	-4	(0)	(+1)	+4
E	(+4)	----	+3	(-3)	(+1)	+11
SE	(+1)	(+2)	(-2)	(-1)	(+5)	(+5)
S	----	(0)	(-1)	(+4)	(+3)	(+6)
SW	(+4)	0	+1	(+3)	+2	(+3)
W	-3	-3	(-2)	-2	+4	+2
NW	+2	(-1)	-1	-3	+1	+7
VRBL	----	----	-1	(+2)	(+2)	+6

*Corrections in ( ) are based on annual rather than bimonthly data.

---- indicates insufficient data for bimonthly or annual correction.

Table 8

Average Error of Objectively-Adjusted and Original Automated Temperature Forecasts and FP Forecasts for the Period July Through December 1971

	MAXIMUM TEMPERATURE				MINIMUM TEMPERATURE				ALL FCSTS			
Month	# Fcsts	Adjusted	Original	FP	# Fcsts	Adjusted	Original	FP	# Fcsts	Adjusted	Original	FP
JULY	74	3.2	3.4	2.6	93	3.5	4.2	3.0	167	3.3	3.8	2.8
AUG	60	2.5	3.1	2.7	87	3.2	3.8	2.4	147	2.9	3.5	2.5
SEPT	59	3.3	3.1	2.4	65	4.1	6.5	2.7	124	3.8	4.9	2.6
OCT	59	4.0	3.9	2.8	78	4.1	5.1	3.7	137	4.1	4.6	3.3
NOV	68	3.3	3.8	3.5	78	3.5	3.8	3.2	146	3.4	3.8	3.4
DEC	69	4.8	4.5	4.1	81	4.6	5.9	3.7	150	4.7	5.3	3.9
ALL	389	3.5	3.6	3.0	482	3.8	4.8	3.1	871	3.7	4.3	3.1

Table 9

Result of Application of Objective Correction	Maximum Temperature	Minimum Temperature	All Fcsts
Improvement	44%	59%	52%
Deterioration	39%	32%	35%
No Change	17%	9%	13%

Table 9 - Effect of Applying Objective Corrections to Automated Temperature Forecasts in the Period July Through December 1971.

LIST OF EASTERN REGION TECHNICAL MEMORANDA

(Continued from inside front cover)

NWS ER 40	Use of Detailed Radar Intensity Data in Mesoscale Surface Analysis. Robert E. Hamilton. March 1971 (COM-71-00573)
NWS ER 41	A Relationship Between Snow Accumulation and Snow Intensity as Determined from Visibility. Stanley E. Wasserman and Daniel J. Monte. May 1971 (COM-71-00763)
NWS ER 42	A Case Study of Radar Determined Rainfall as Compared to Rain Gage Measurements. Martin Ross. July 1971 (COM -71-00897)
NWS ER 43	Snow Squalls in the Lee of Lake Erie and Lake Ontario. Jerry D. Hill. August 1971 (COM-71-00959)
NWS ER 44	Forecasting Precipitation Type at Greer, South Carolina. John C. Purvis. December 1971 (COM-72-10332)
NWS ER 45	Forecasting Type of Precipitation. Stanley E. Wasserman. January 1972 (COM-72-10316)
NWS ER 46	An Objective Method of Forecasting Summertime Thunderstorms. John F. Townsend and Russell J. Younkin. May 1972 (COM-72-10765)
NWS ER 47	Forecast Cloud Cover Study. James R. Sims. August 1972