NOAA Western Region Computer Programs and Problems NWS WRCP - No. 6342

AEV LOCAL VERIFICATION FOR AVIATION, PRECIPITATION, AND TEMPERATURE PROGRAMS: AV, REL, TEM

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Salt Lake City, Utah
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U.S. DEPARTMENT OF COMMERCE / National Oceanic and Atmospheric Administration / National Weather Service

PREFACE

This Western Region publication series is a subset of our Technical Memorandum series. This series will be devoted exclusively to the exchange of information on and documentation of computer programs and related subjects. This series was initiated because it did not seem appropriate to publish computer program papers as Technical Memoranda; yet, we wanted to share this type of information with all Western Region forecasters in a systematic way. Another reason was our concern that in the developing AFOS-era there would be unnecessary and wasteful duplication of effort in writing computer programs in National Weather Service (NWS). Documentation and exchange of ideas and programs envisioned in this series hopefully will reduce such duplication. We also believe that by publishing the programming work of our forecasters, we will stimulate others to use these programs or develop their own programs to take advantage of the computing capabilities AFOS makes available.

We solicit computer-oriented papers and computer programs from forecasters for us to publish in this series. Simple and short programs should not be prejudged as unsuitable.

The great potential of the AFOS-era is strongly related to local computer facilities permitting meteorologists to practice in a more scientific environment. It is our hope that this series will help in developing this potential into reality.

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36 Soaring Forecast Program. D.S. Toronto and G. R. Lussky, Revised March 1986. (PB86 173523/AS)
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42 AEV Local Verification for Aviation, Precipitation, and Temperature Programs: AV, REL, TEM. Timothy W. Barker, Revised September 1987. (PB88 115662/AS)
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54 Hemispheric Spectral Analysis Program. Craig C. Peterson, April 1986. (PB 183662/AS)
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56 SWELL Program. Craig C. Peterson, August 1987. (PB87 229795/AS)
57 Watchdog Program. William R. Schneider and Craig C. Peterson, October 1988. (PB89 122535/AS) - Revised June 1991 (PB91-218180/AS)
58 Daily Climate Summary for MAPSO. Joe L. Johnston, August 1989. (PB89 230841/AS) - Revised May 1991. (PB91-200691/AS)
59 SEAPLOT. Bob Diaz and Steve Todd, December 1989. (PB90 151333/AS)
60 NWWS Product Retransmission Program. William R. Schneider, March 1990. (PB90 199092/AS)
61 A System of Collecting RAWS Data For Dissemination over AFOS. Dennis D. Gettman, January 1991. (PB91-153460)
62 CLINEWS. Ray Stuyvesant, May 1991. (PB91-200709/AS)

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October 4, 1993 W/WR3x4:KWM

MEMORANDUM FOR: CP and AFOS Distribution

FROM: W/WR3x4 - Keith W. Meier

SUBJECT: Updated Local AFOS Era Verification (AEV) Software and Documentation

In response to numerous requests and suggestions from the field, the Local AFOS Era Verification (AEV) software has been updated. The accompanying Western Region Computer Programs and Problems, No. ~~63~~ 42, discusses the new features within the software, as well as the software, in general.

The following list highlights the changes that were made in the software and the originator of the suggested modification.

- Add options within VERDAT to break out a single month of the file, which could be archived onto a floppy disk, and to put back a month of data into the VERD## file. (Steve Brown - WSFO Reno)
- Add options to the period switch to score only daytime/nighttime periods. (Greg Hooker - WSFO Seattle)
- Add a switch to score a specified list of dates, which are contained in a separate file edited by the user. (Greg Hooker - WSFO Seattle)
- Compute "% too high" and "% too low" for temperatures. (Greg Hooker - Seattle)
- Denote the temperature error classes as positive and negative. (Larry Kierulff - WSFO Seattle)
- Allow user defined error classes. (Larry Kierulff - WSFO Seattle)
- Compute improvement over persistence for temperatures. (Larry Kierulff - WSFO Seattle)
- Separate the view option in VERDAT from the initialize option. (Bill Randel - WSFO Boston)

- Automatically print data for the most recent day observations for which verifying exist for all forecast periods and cycles (either from ADM or dasher). (Bill Randel - WSFO Boston)

- Include Albany's FEDS score for temperature and precipitation. (George Maglaras - WSFO Albany)

- Add a switch to calculate forecaster scores without MOS. This choice provides scoring against persistence rather than MOS. (Gordon Hammons - SRH/SSD)

Any questions related to the Local AEV software may be directed to Keith Meier at (801)-524-5131.

Enclosure

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NOAA Western Region Computer Programs and Problems NWS WRCP - No. 63

AEV LOCAL VERIFICATION FOR AVIATION, PRECIPITATION, AND TEMPERATURE PROGRAMS: AV, REL, TEM

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September 1993, Revision

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This technical publication has been reviewed and is approved for publication by Scientific Services Division, Western Region.

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LIST OF TABLES

I. Introduction

These programs take advantage of the verification data files generated by the AFOS Era Verification (AEV) software (Ruth and Alex, 1987). The AEV software maintains a short file containing verification data for the previous few days. The AEV software was developed to permanently save this verification data in large local files and create verification scores based on this data. The parameters to be verified and scores to be used were partially determined by the National Verification Committee based on the National Verification Plan (1982).

Many new features have been added to this version of the Local AEV software package. The program VERDAT incorporates four new options and modifies a pre-existing option. The "View and/or Initialize One Day" option was separated into two separate options to allow these options to run less interactively. An additional option within VERDAT will automatically print the data for a day, two days prior to the current system date. This will allow a user to print the most recent data file, for which verification data exists, from within a macro as part of Watchdog. The remaining two new options allow: 1) a user to extract the data for one month from the VERD## file and store it in a separate file and eventually onto a floppy disk; and 2) a user to put a monthly data file into a yearly, VERD##, data file. The large size of the VERD## files make them impossible to backup onto floppy diskettes. By providing an option for dividing the large VERD## files into smaller monthly files, the possibility for archiving monthly or yearly data now exists.

Several other additions were made to the Local AEV software. Switches were added to compute scores: 1) using a file containing a list of forecast dates which are to be scored; 2) with MOS or persistence; 3) using user-specified error class widths; 4) using a specified value by which MOS had changed; 5) using a specified value which MOS or a local forecast exceeded; 6) using a specified value for which there was a threat of change in excess. The period switch was modified to allow scoring for day and night periods.

Temperature alphanumeric output depicts the signs of errors and includes scores of "% Too High" and "% Too Low". The FEDS score (Maglaras, 1991) for both temperature and precipitation were also included in the new software. The aviation (AV) program computes a Heidke skill score.

II. Methodology and Software Structure

All four programs are written in Data General FORTRAN IV revision 5.57. The VERDAT program reads the VERccc and VERDIR files produced by the AEV software and stores the correct data in the local VERD## files. The VERDAT program also provides a few options to initialize or print portions of the VERD## files, or store/restore data for a month in a separate file . The three verification programs (TEM, AV, and REL) generate scores and statistics based on the data stored in the VERD## files. The TEM program generates temperature verification scores, the AV program generates ceiling and visibility verification scores, and the REL program generates probability of precipitation verification scores.

A. Data Maintenance Program

1. VERDAT

a) General Description

The main routine VERDAT provides a menu of options to create, initialize, print, and maintain the verification data in files VERD## (where ## is the year). Data files containing monthly data (VERDmmyy, where mm and yy are two digit months and years, respectively) may be created from or restored to the VERD## files. The appropriate subroutines are called according to operator input at the Dasher.

b) Special Subroutines

Subroutine INITDAT initializes an entire year of VERD## data according to operator input at the Dasher. Any data which already exists for the specified year is erased. Subroutine INITYR is called to complete the actual initialization.

Subroutine MONTH initializes all or part of any month according to operator input at the Dasher. Any data which already exists for the specified dates is erased.

Subroutine DAY initializes one day of the verification file.

Subroutine PRINT prints the data which exist for any day, station, and cycle on the Dasher or AFOS PPM according to operator input at the Dasher.

Subroutine AUTOPR automatically prints the verification data for the date two days prior to the current system date. This ensures that the data contains verifying observations for all periods.

Subroutine LOAD moves data from the AEV files VERccc and VERDIR into the local verification files VERD##. If the VERD## file does not exist (e.g., on January 1), subroutine INITYR is called to initialize the entire year before the current data is stored.

Subroutine MONOUT creates a monthly data file (VERDmmyy) and puts all data for a specified month into that file. This allows storage of verification data onto floppy disks.

Subroutine MNTHIN puts data from a monthly file (VERDmmyy) into a yearly file (VERD##). This allows a user

to recreate a yearly file from monthly data which has been saved on floppy disks. The yearly file (VERD##) must exist prior to exercising this option.

c) Command Line

The VERDAT program should be run daily after the AEV program VERIFY is run. This program can be initiated at the Dasher by typing VERDAT. To facilitate automation of the daily data maintenance operation, VERDAT may be initiated from within a macro with the command line VERDAT 4, The 4 specifies that option 4 should be selected, and since no further Dasher input is required for this option, VERDAT can run successfully without operator intervention. Likewise, automatically printing data from two days earlier (option 6) may also be run within a macro.

d) Error Messages

Fatal errors related to disk access will cause program termination and the following error messages to be printed at the Dasher:

INITYR GCHN ERROR	-	Can't get an output channel
INITYR CRAND ERROR	-	Can't create new VERD## file
INITYR LINK1 ERROR	-	Can't create link from default directory to USER2
INITYR WRB ERROR	-	Can't write to VERD## file
INITYR KLOSE ERROR	-	Can't close VERD## file
ERROR OPENING YEAR	-	Can't open specified year
MONTH--OUTPUT ERROR	-	Can't write to specified dates
DAY OPENN ERROR	-	Can't open output device
DAY RDB ERROR	-	Can't read data for specified date
DAY WRL ERROR	-	Can't write to specified output device
DAY WRB ERROR	-	Can't write to VERD## file
LOAD GCHN ERROR	-	Can't find open output channel
LOAD OPEN ERROR	-	Can't open specified file
LOAD RDS ERROR	-	Can't read specified file
LOAD RDB ERROR	-	Can't read specified file
LOAD WRB ERROR	-	Can't write to VERD## file
LOAD KLOSE ERROR	-	Can't close VERD## file

B. Verification Scoring Programs

All the scoring programs have the same general algorithm. Subroutine SWITCH is called to decode the command lines, the VERD## files are read and the appropriate scores and statistics are calculated. Special subroutines are called by each program to generate the graphics and alphanumeric AFOS products.

1. TEM - Temperature Verification

   a) Special Subroutines

      Subroutine TEMTAB generates the alphanumeric AFOS product TEMPCHECK from the scores and statistics calculated in the main program.

      Subroutine TEMGPH generates the AFOS graphic NMCGPHTEM from statistics calculated in the main program. The AG.LB library is used to create the graphic NMCGPHTEM.

2. REL - Precipitation Verification

   a) Special Subroutines

      Subroutine PCPNTB generates the alphanumeric AFOS product PCPNTABLE from scores and statistics calculated in the main program.

      Subroutine RELGPH generates the AFOS graphic NMCGPHREL from statistics calculated in the main program. The AG.LB library is used to create the graphic NMCGPHREL.

3. AV - Aviation Verification

   a) Special Subroutines

      Subroutine AVGPH generates the AFOS graphic NMCGPHAV1 from statistics calculated in the main program. The AG.LB library is used to create the graphic NMCGPHAV1.

      Subroutine VCAT converts visibility observations from miles to an appropriate aviation flight rules category (LIFR, IFR, MVFR, VFR), and also converts the visibility to meters for calculation of the visibility log score.

      Subroutine CCAT converts ceiling observations from hundreds of feet to an appropriate aviation flight rules category (LIFR, IFR, MVFR, VFR).

4. Command Line

All the verification scoring programs can be initiated from an ADM console, the Dasher, a macro, or a procedure. There are thirteen optional switches available for use with the scoring programs to define the verification criteria. Not all of the switches apply to each of the three verification programs. These switches, which may appear in any order, are listed below with their default values.

		Switch	Example	Default
1.	Station	XXX/L	SLC/L	All Stations
2.	Period	#/P	2/P	All Periods
3.	Forecaster #	#/F	25/F	All Forecasters
4.	Starting Date	#/S	050193/S	6 months prior to current date
5.	Ending Date	#/E	123193/E	Current Date
6.	Cycle	#/C	0/C or 12/C	Both Cycles
7.	Season	#/N	1/N or 2/N	Both Seasons
8.	Error Class Width	#/W	5/W	3° (must be odd)
9.	MOS Changed By	#/M	5/M	3°
10.	MOS/Local error >	#/A	4/A	6°
11.	Threat of Chg >	#/T	5/T	10°
12.	Verify using MOS	#/X	1/X or 0/X	1 (Yes)
13.	Use list of dates	#/D	1/D or 0/D	0 (No)

Period switch	**Scores this period**
1	First period
2	Second period
3	Third period
4	Fourth period (not valid for precipitation)
5	First and third periods
6	Second and fourth periods (no fourth period for precipitation)

This switch, in combination with the cycle switch, may be used to score for daytime and nighttime periods. For example, using the cycle switch 0/C and the period switch 5/P the Local AEV program TEM would produce verification scores for high temperatures only from the 00Z cycle. Similarly, by using the cycle switch 0/C and 6/P the Local AEV program TEM would produce verification scores for low temperatures only from the 00Z cycle.

The dates for starting and ending date switches must be entered in MMDDYY format, where MM is the month, DD is the day, and YY is the year. Zeros must preceed any number less than 10, such that this date is 6 characters long. For example, December 12, 1986 is entered as 121286, and February 4, 1985 is entered as 020485.

The season switch can be set to 1 for cool season scores (October 1 - March 31), or 2 for warm season scores (April 1 - September 30). Only forecasts made on days that satisfy both the season and date switches are used in calculating verification scores. If no dates are specified with a season switch, only those days that satisfy the season switch within the last six months will be scored. Therefore, to verify the entire previous warm season, the starting date must be no later than April 1, and the ending date must be no earlier than September 30.

The error class width switch must be an odd number to prevent overlapping error classes and meaningless calculations. The program will run with even error classes, but overlapping error classes result in useless statistics.

The MOS switch can be set to 0, which would compute scores versus persistence rather than MOS. The default (1) is to score against MOS, but this switch allows those sites without MOS to use the local AEV software to score versus persistence. It also allows sites with MOS to score against persistence, in addition to MOS, although not simultaneously.

Persistence for a period 1 forecast will also be persistence for a period 3 forecast, and similarly, a persistence for period 2 will also be persistence for period 4. Scoring versus persistence is **not** a valid option for precipitation verification.

Persistence forecast for temperature verification:

> 00Z cycle - Observed temperatures for periods 1 and 2 from 00Z cycle of previous day
>
> 12Z cycle - Observed temperatures for periods 1 and 2 from 12Z cycle of previous day

Persistence forecast for aviation verification:

> 00Z cycle - Observed ceiling and visibility for period 4 from 12Z cycle of previous day
>
> 12Z cycle - Observed ceiling and visibility for period 3 from 00Z cycle of that day.

The list of dates switch will read a file (LODS) containing a list of six digit forecast dates to score. The date contained in each line of this file corresponds to the date the forecast was made for the particular event of interest. Each line of this file must contain only one forecast date. Additional forecast dates must be specified on succeeding lines. The default (0) does not look for this file.

C. Common Subroutines

1. SWITCH

Subroutine SWITCH decodes the command line switches for the scoring programs and sets the defaults for switches not specified in the command line.

2. JUDTE

Subroutine JUDTE converts a date from month/day format to Julian format (1-366). The Julian date provides an easy way to reference the VERD## file because each day occupies 4 blocks of the VERD## file. The starting block of the data for each day is given by:

((Julian date - 1) * 4).

3. NUMTEX

Subroutine NUMTEX converts a floating point number into an ASCII string in a similar manner to normal FORTRAN FORMAT statements. The routine handles negative numbers and may print up to 2 decimal places. The last digit printed is rounded.

D. Data File Format

All verification data for one year is stored in a VERD## file, where ## is the year. Each of these files is 1464 blocks in length with 4 blocks of data for each day. A 4 block area is always left for February 29 even if the year is not a leap year. Each 4 block area contains 24 records of 40 words. This provides enough space to verify all 12 stations listed in the AEV file VERDIR for two cycles each day (i.e. one station for one cycle requires 40 words).

The 24 records may be in any order as long as they begin successively at word #1, 41, 81, 121, etc. within each 4 block area. Table 1 summarizes the position of the data within each 40 word record. Missing values are stored with all bits on or set at (-1).

Words 1-2	Station call letters. The right byte of the second word is a null.
Word 3	Day of month multiplied by 100, plus the cycle number (00 or 12) for the forecast.
Word 4	Public forecaster number multiplied by 100, plus the aviation forecaster number.
Words 5-12	Temperature forecasts and observations. The MOS and

local forecast temperatures for each period are combined in a single word. The MOS forecast is in the left byte of the word, and the local forecast in the right byte. All temperatures are stored in degrees Fahrenheit plus 100. For example, 53°F would be stored as 153.

Words 13-18

Probability of precipitation amount. Again the MOS and local forecasts are combined in a single word with the MOS forecast in the left byte and the local forecast in the right byte. Observed precipitation is stored in hundredths of inches. For example, 3.15 inches would be stored as 315. A trace is stored as -2.

Word 19

This word contains missing values since it is no longer used. MOS (NGM) ceiling forecast categories. The MOS ceiling categories for all periods are combined into a single word with each value occupying 4 bits. The six categories are defined by the following criteria:

Category	Ceiling
1	< 200
2	200 - 400
3	500 - 900
4	1000 - 3000
5	3100 - 6500
6	6600 - 12000
7	> 12000

Words 21-23

Local forecast and observed ceiling. Each word contains two values; one in the left byte and one in the right byte of the word. The ceilings are stored in hundreds of feet with 96 for a ceiling above 9000 feet and 97 for an unlimited ceiling.

Word 24

This word contains missing values since it is no longer used. MOS (NGM) visibility forecast categories. The visibility categories for all periods are combined into a single word with each value occupying 4 bits. The six categories are defined by the following criteria:

Category	Visibility (miles)
1	< 1/2
2	1/2 - 7/8
3	1 - 2 3/4
4	3 - 5
5	> 5

Word 25-28	Local forecast and observed visibilities. Each word contains two values; one in the left byte and one in the right byte of each word. The visibilities are stored with the first digit in miles and the second digit in quarters of miles. For example, a visibility of 3 3/4 miles will be stored as 33. Visibilities over 7 miles are stored as 80.
Word 29-40	Wind forecasts and observations. All winds are stored in DDFF format where DD is the direction (in tens of degrees) and FF is the speed (in knots). If the speed exceeds 100 knots, 100 is subtracted from the speed and 50 is added to the direction. For example, winds from 130 degrees at 24 knots will be stored as 1324. The 42 h local forecast wind is only stored as 2322 for significant wind forecast and 2302 for no significant wind forecast.

Table 1. Data for One Station and One Cycle

Word	Information	
1-2	Station call letters	
3	Day/cycle	
4	Public forecaster #/Aviation forecaster #	
5	MOS Temp/Local Temperature	12-24 h
6	Observed Temperature	
7	MOS Temp/Local Temperature	24-36 h
8	Observed Temperature	
9	MOS Temp/Local Temperature	36-48 h
10	Observed Temperature	
11	MOS Temp/Local Temperature	48-60 h
12	Observed Temperature	
13	MOS PoP/Local PoP	12-24 h
14	Observed Amount	
15	MOS PoP/Local PoP	24-36 h
16	Observed Amount	
17	MOS PoP/Local PoP	36-48 h
18	Observed Amount	
19	MOS Ceiling Category/MC/MC/MC	12/15/18/24 h
20	Local Ceiling/Local Ceiling	03/06 h
21	Local Ceiling/Local Ceiling	09/15 h
22	Observed Ceiling/Observed Ceiling	03/06 h
23	Observed Ceiling/Observed Ceiling	09/15 h
24	MOS Visibility Category/MV/MV/MV	12/15/18/24 h
25	Local Visibility/Local Visibility	03/06 h
26	Local Visibility/Local Visibility	09/15 h
27	Observed Visibility/Observed Visibility	03/06 h
28	Observed Visibility/Observed Visibility	09/15 h
29	MOS Wind	12 h
30	Local Wind	3 h
31	Peak Sustained Wind	0-6 h
32	MOS Wind	18 h
33	Local Wind	6 h
34	Peak Sustained Wind	3-9 h
35	MOS Wind	24 h
36	Local Wind	9 h
37	Peak Sustained Wind	6-12 h
38	MOS Wind	42 h
39	Local Wind	42 h
40	Peak Sustained Wind	39-45 h

NOTE: Ceilings, visibilities, and winds at 3, 6, 9, and 15 h are relative to the FT issuance time, not the cycle time (with the exception of MOS).

E. Scoring Formula

1. Temperature Mean Absolute Error (MAE):

$$MAE = \frac{\Sigma \, | T_f - T_o |}{N}$$

where T_f = Forecast Temperature
T_o = Observed Temperature
N = Number of Forecasts

2. Temperature Mean Error (Bias):

$$Bias = \frac{\Sigma \, (T_f - T_o)}{N}$$

where T_f = Forecast Temperature
T_o = Observed Temperature
N = Number of Forecasts

3. Precipitation Brier Score

$$Brier = \frac{(\Sigma \, ((PoP - Ob)^2 / 100^2)) \times 100}{N}$$

where PoP = Forecast PoP
Ob = 0 for no precip, 1 for precip
N = Number of forecasts

4. Aviation Log Score (MacDonald, 1977)

$$Log\ Score = (50 / N) * \Sigma \, (\log_{10} (f/o))$$

where f = Forecast ceiling (feet) or visibility (meters)
o = Observed ceiling or visibility
N = Number of forecasts

5. Percentage Improvement

$$\% \text{ IMP} = ((M - F) / N) * 100 \qquad |\% \text{ IMP}| \leq 99.9\%$$

where M = MOS Score
F = Local Forecaster Score

6. WSFO Albany's FEDS Score

FEDS(Temperature)= [[C * I] / 10] + M

where C = Percent of total forecasts when MOS was changed by 3 or more degrees
I = Percent improvement of mean absolute error over MOS when MOS was changed by 3 or more degrees
M = Percent improvement of mean absolute error over MOS

FEDS(Precipitation) = [[C * I] / 10] + M

where C = Percent of total forecasts when local PoPs differed from MOS PoPs by 20% or more
I = Percent improvement of local brier score over MOS for cases when local PoPs differed from MOS PoPs by 20% or more
M = Percent improvement of local brier score over MOS

7. Heidke Skill Score

Heidke Skill Score = (C - E) / (N - E)

where C = # of correct forecasts ($n_{11} + n_{22} + n_{33} + n_{44}$)
N = # of total forecasts (n_{00})
E = # of expected correct forecasts due to random chance (($n_{01}n_{10} + n_{02}n_{20} + n_{03}n_{30} + n_{04}n_{40}$) / n_{00}

Forecast

		LIFR	IFR	MVFR	VFR	SUMS
O	LIFR	n_{11}	n_{12}	n_{13}	n_{14}	n_{10}
B	IFR	n_{21}	n_{22}	n_{23}	n_{24}	n_{20}
S	MVFR	n_{31}	n_{32}	n_{33}	n_{34}	n_{30}
V	VFR	n_{41}	n_{42}	n_{43}	n_{44}	n_{40}
D	SUMS	n_{01}	n_{02}	n_{03}	n_{04}	n_{00}

F. Description of Output

1. VERDAT

VERDAT option 5 (View One Day) will print out the verification data for one day at any station and for any cycle. An example of this output is shown in Fig. 1. Data is printed in the following format:

Temps:	MOS Forecast/Local Forecast/Observed Temp
PoPs:	MOS PoP/Local PoP/Observed Amount
Ceilings:	Local Forecast/Observed Ceiling
Visibility:	Local Forecast/Observed Visibility
Winds:	MOS Forecast/Local Forecast/Observed Wind
MOS CIG/Vis:	MOS Ceiling Category/MOS Vis. Category

2. TEM

AFOS graphic NMCGPHTEM (Fig. 2) displays the temperature error distribution for local and MOS forecasts for all 4 periods. The data used to calculate these percentages will always be exactly homogeneous; only those days with a MOS forecast, local forecast and verifying temperature are included in the data set. Each quadrant displays 2 bar graphs; one for MOS and one for local forecasts. Each bar represents the percentage of forecasts with the specified temperature error. Nine error categories are displayed along the X-axis. The far end categories show the percentage of forecasts in which the forecast was at least 10 degrees (or switch T) too high or low. The other categories are 3 degrees wide (or switch W and M); +1 and -1 degree on either side of the number displayed beneath the center of the bar. For example, the category labeled -3 contains the percentage of forecasts in which the forecast was 2, 3, or 4 degrees too low. The number of local forecasts in each category is printed above the bar and the number of MOS forecasts is printed at the 80% level. The ideal curve would be highest in the center and lowest on the sides - a bell curve. A special map background is required for display (initially named TEMBACK on floppy diskette).

AFOS alphanumeric product TEMPCHECK (Fig. 3) displays various temperature scores and statistics. A description of each of the values is shown in Table 2 - Quick Guide to Temperature Verification Output. A threat of a 24 h temperature change of 10 or more degrees (or switch T) is defined as any time when the MOS or local temperature is forecast to change by 10 or more degrees (or switch T), or the observed temperature actually changes by 10 or more degrees (or switch T) in 24

h. For periods 1 and 2 the forecast 24 h change is calculated by comparing the forecast to the observed temperature 24 h previous to the verifying time. For period 3 the forecast 24 h change is calculated by comparing the forecast temperature to the temperature forecast during period 1. Likewise, the period 4 forecast 24 h change is calculated by comparing the period 4 forecast temperature to the period 2 forecast temperature. On the first of verification specified by the switches, the temperatures from 24 h earlier are not known, so 24 h changes cannot be calculated for periods 1 and 2 of 00Z cycles and period 1 of 12Z cycles on the first day of any verification period. This situation also occurs on the first day of a season when verification is requested for only 1 season.

2. REL

AFOS graphic product NMCGPHREL (Fig. 4) displays the percentage of times precipitation occurred when each PoP value was forecast by MOS and local forecasters (called a reliability curve). The number of times each PoP value was forecast is printed near the forecast reliability line, and along the bottom of the graph for the MOS reliability line. To reduce clutter on the graphic, the number of 5% forecasts is not displayed unless the GDM is set to a zoom of 4:1 or higher. Any 2% forecasts are changed to 0%. If the GDM is set to a dashed or dotted display, the MOS reliability line will change, but the forecaster reliability line will remain solid. Basically, points which fall above the idealized line indicate under forecasting; for example in Fig. 4 for local PoP forecast of 50% it was observed to rain 50% of the time. Conversely, points below the line are indicative of over forecasting. If a point lies along the bottom of the graph, it means either no forecasts were issued for this category or precipitation never occurred when this category was forecast. A special map background is needed for display (initially named RELBACK on floppy diskette).

AFOS alphanumeric product PCPNTABLE (Fig. 5) displays several verification scores for precipitation forecasts. These scores are described in Table 3 - Quick Guide to Precipitation Verification Scores.

3. AV

AFOS graphic product NMCGPHAV1 (Fig. 6) displays verification matrices and aviation log scores for ceiling and visibility forecasts. The scores are described in Table 4 - Quick Guide to Aviation Verification Scores. The local forecasts are verified against a persistence forecast since MOS forecasts generally do not verify at the same times as the local forecasts. The persistence value is determined from the verifying values of the previous cycle (see Table 5). For example, the 15 h forecasts from the 12Z cycle are valid at the same time that 00Z forecasts become valid, so the 15 h verifying observations are used to

generate the persistence forecast for the 00Z cycles. Likewise, the 9 h forecasts from the 00Z cycle are valid at the same time that the 12Z cycle forecasts become valid, and thus, the 9 h verifying observations are used to generate the persistence forecast for 12Z cycles. A special map background is needed for display (initially named AVBACK on floppy diskette).

III. CAUTIONS AND RESTRICTIONS

The validity of the verification scores and statistics depends upon the size of the sample. The software is flexible enough to allow for some very specific selection of situations (for example: two years of cool season 4th period temperatures for one forecaster at a particular site). Without a significant number of cases, the statistics are meaningless, so care must be exercised in drawing conclusions from small data sets.

The VERD## files are fairly large (1464 RDOS blocks) and are never deleted within the programs themselves. New VERD## files are created as needed within the programs. Stations can elect to keep as many years as feasible, considering disk space requirements (three years recommended). It is now possible to use floppy diskettes to store data by months, which may then be put back into a yearly files using the VERDAT software.

The large number of switches can pose a problem when initiating the programs from an ADM. Only 24 characters are available in the command line on an ADM, which is not enough to allow specifying all thirteen switches at once. In cases where this becomes a problem, initiate the program at the Dasher or from a macro since the command line length is virtually unlimited in these cases.

IV. ACKNOWLEDGEMENTS

These programs were initially written by Lawrence Dunn, and since modified by Timothy Barker and Steve Keighton. The newer programs, although substantially different, would not have been possible without the work of the earlier versions and the assistance of Timothy Barker.

V. REFERENCES

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MacDonald, A. E., May 3, 1977: Aviation Log Score. Western Region Technical Attachment #77-18.

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

Maglaras, George J., 1991: Eastern Region Technical Attachment No. 91-7B (August), Frequently and Effectively Departs Significantly (FEDS) Score.

Doswell, C. A., R. Davies-Jones, and D. L. Keller, 1990: On summary measures of skill in rare event forecasting based on contingency tables. *Wea. Forecasting*, **5**, 576-585.

Table 2 - Quick Guide to Temperature Verification Scores

# FCSTS	Number of forecast in sample
MAE	Mean absolute error in degrees
% IMP OVR MOS	Percent improvement of mean absolute error over MOS
MEAN ERROR (DEG)	Mean error (bias) in degrees
# CHGD GE 3	Number of times MOS was changed by 3 or more degrees
% CHGD GE 3	Percent of total forecasts when MOS was changed by 3 or more degrees
MAE CHGD GE 3	Mean absolute error when MOS was changed by 3 or more degrees
% IMP CHGD BE 3	Percent improvement of mean absolute error over MOS when MOS was changed by 3 or more degrees
# ERR GE 6	Number of forecasts when either MOS or local error was 6 or more degrees
MAE ERR GE 6	Mean absolute error when either MOS or local error was 6 or more degrees
% IMP ERR GE 6	Percent improvement of forecaster mean absolute error over MOS when either MOS or local error was 6 or more degrees
# THT GE 10	Number of forecasts when there was a threat of a temperature change of 10 or more degrees in 24 hours. The definition of this threat is when any of the following occur: a) Local forecast 24-hour change is 10 or more degrees b) MOS forecast 24-hour change is 10 or more degrees c) A 24-hour change of 10 or more degrees actually occurred NOTE: Period 1 and 2 forecast 24-hour changes are calculated from observed temperature of previous 24 hours. Period 3 and 4 forecast 24-hour changes are calculated from forecast temperature 2 periods earlier.
MAE THT GE 10	Mean absolute error when there was a threat of a temperature change of 10 or more degrees in 24 hours.
% IMP THT GE 10	Percent improvement of forecaster mean absolute error over MOS when there was a threat of a temperature change of 10 or more degrees in 24 hours.
% IN ERROR CLASSES	Percent of total forecasts in error classes. Nine error classes, determined by the error class width, correspond to the nine error classes displayed on the graphic NMCGPHTEM. The abolute error classes also correspond to the error class width.
% TOO HIGH (LOW)	Percent of forecasts which where too high and too low. Does not include the number of perfect forecasts
FEDS	WSFO Albany's Frequently and Effectively Departs Significantly score

Table 3 - Quick Guide to Precipitation Verification

# FCSTS	Number of forecasts in sample
# PCPN CASES	Number of observed precipitation events
PCPN FREQ	Percent of cases with precipitation
MEAN POP	Mean Probability of Precipitation (PoP)
MEAN POP (DRY)	Mean PoP when no precipitation occurred
MEAN POP (WET)	Mean Pop when precipitation occurred
BRIER SCORE	Brier score for all forecasts
% IMP OVR MOS	Percent improvement of local brier score over MOS
# LCL POPS GE 30%	Number of cases where local PoPs were 30% or greater
% IMP POPS GE 30%	Percent improvement of local brier score over MOS for cases when local PoPs were 30% or greater
% IMP (WET)	Percent improvement of local brier score over MOS for cases when precipitation occurred
# CHGD GE 20%	Number of cases when local PoPs differed from MOS PoPs by 20% or more
% CHGD GE 20%	Percent of total forecasts when local PoPs differed from MOS PoPs by 20% or more
% IMP CHGD GE 20%	Percent improvement of local brier score over MOS for cases when local PoPs differed from MOS PoPs by 20% or more
TOTAL % CORRECT	Percent of total forecasts which were correct. Correct forecast is defined as: a) PoP less than 50% and no precipitation b) PoP 50% or greater and precipitation occurred
FEDS	WSFO Albany's Frequently and Effectively Departs Significantly score

Table 4 - Quick Guide to Aviation Verification Scores

Category	Ceiling (feet)	Visibility (miles)
LIFR	< 500	< 1
IFR	500 - 999	1 - 2.99
MVFR	1000 - 3000	3 - 5
VFR	> 3000	> 5

BIAS	Number of forecasts in category, divided by actual number of cases of that category observed. Values less than 1 indicate under forecasting (category occurred more than forecast). Values greater than 1 indicate over forecasting (category occurred less than forecast).
% CORRECT	Percent of total forecasts which verified in same category as forecast
LOG SCORE	Log score of all forecasts
VS. PERSIS	Log score for local forecasts when persistence forecast was also available
% IMP OVR PERSIS	Percent improvement of local log score over persistence when both local and persistence forecasts were available
HEIDKE SCORE	Statistical score based on contingency tables, which better measures skill in rare event forecasts

Table 5 - FT Issuance and Valid Tmes for Each Cycle

	00Z Cycle					12Z Cycle				
Time Zone	Issued	3 h	6 h	9 h	15 h	Issued	3 h	6 h	9 h	15 h
EST	0900	1200	1500	1800	0000	1800	2100	0000	0300	0900
EDT	0800	1100	1400	1700	2300	1700	2000	2300	0200	0800
CST	0900	1200	1500	1800	0000	1800	2100	0000	0300	0900
CDT	0800	1100	1400	1700	2300	1700	2000	2300	0200	0800
MST	1000	1300	1600	1900	0100	1900	2200	0100	0400	1000
MDT	0900	1200	1500	1800	0000	1800	2100	0000	0300	0900
PST	1100	1400	1700	2000	0200	2000	2300	0200	0500	1100
PDT	1000	1300	1600	1900	0100	1900	2200	0100	0400	1000

```
                12-24 HRS          24-36 HRS          36-48 HRS          48-60 HRS
TEMPS          68/ 64/ 63         46/ 46/ 49         63/ 62/ 52         47/ 47/ 47
POPS           80/ 90/ T          90/ 90/  1         70/ 90/ 14

                  3 HR               6 HR               9 HR              15 HR
CEILINGS       20/40              20/65              50/96              50/65
VISIBILITY     60/80              60/80              80/80              80/80

                  3 HR               6 HR               9 HR              42 HR
WINDS      1710/1810/1725     2013/1814/1725     2809/1814/2220     2906/2302/1609

                 12 HR              18 HR              24 HR
MOS CIG/VIS       5/6                4/6                5/6
================================================================================
VERIFICATION DATA FOR CDC FROM 00Z 06 JUN 93    PUBLIC FCSTR 02    AVN FCSTR 21

                12-24 HRS          24-36 HRS          36-48 HRS          48-60 HRS
TEMPS          59/ 57/ 54         35/ 35/ 40         63/ 64/ 62         36/ 36/ 44
POPS           90/ 90/ T          60/ 60/  0         30/ 30/  0

                  3 HR               6 HR               9 HR              15 HR
CEILINGS       15/11              45/97              45/90              45/90
VISIBILITY     60/80              80/80              80/80              80/80

                  3 HR               6 HR               9 HR              42 HR
WINDS      2117/2000/2316     1914/2112/2222     2107/2112/2321     2407/2302/1916

                 12 HR              18 HR              24 HR
MOS CIG/VIS       5/6                5/6                5/6
================================================================================
VERIFICATION DATA FOR SLC FROM 12Z 06 JUN 93    PUBLIC FCSTR 09    AVN FCSTR 22

                12-24 HRS          24-36 HRS          36-48 HRS          48-60 HRS
TEMPS          44/ 48/ 49         62/ 61/ 52         49/ 48/ 47         65/ 65/ 65
POPS           70/ 70/  1         70/ 80/ 14         50/ 60/  3

                  3 HR               6 HR               9 HR              15 HR
CEILINGS       60/97              60/65              25/65              25/65
VISIBILITY     80/80              80/80              80/80              80/80

                  3 HR               6 HR               9 HR              42 HR
WINDS      2512/1710/2220     2805/2215/1917     1806/2215/1816     1804/2302/1308

                 12 HR              18 HR              24 HR
MOS CIG/VIS       5/6                5/6                5/6
================================================================================
VERIFICATION DATA FOR CDC FROM 12Z 06 JUN 93    PUBLIC FCSTR 09    AVN FCSTR 22

                12-24 HRS          24-36 HRS          36-48 HRS          48-60 HRS
TEMPS          31/ 36/ 43         62/ 63/ 62         38/ 37/ 44         73/ 71/ 67
POPS           50/ 60/  0         40/ 50/  0         30/ 30/  9

                  3 HR               6 HR               9 HR              15 HR
CEILINGS       40/97              40/90              11/97              11/65
VISIBILITY     80/80              80/80              80/80              80/80

                  3 HR               6 HR               9 HR              42 HR
WINDS      2110/1915/2222     2003/2314/2120     2104/2314/2112     2902/2302/2911

                 12 HR              18 HR              24 HR
MOS CIG/VIS       5/6                6/6                6/6
```

Fig. 1 VERDAT Output

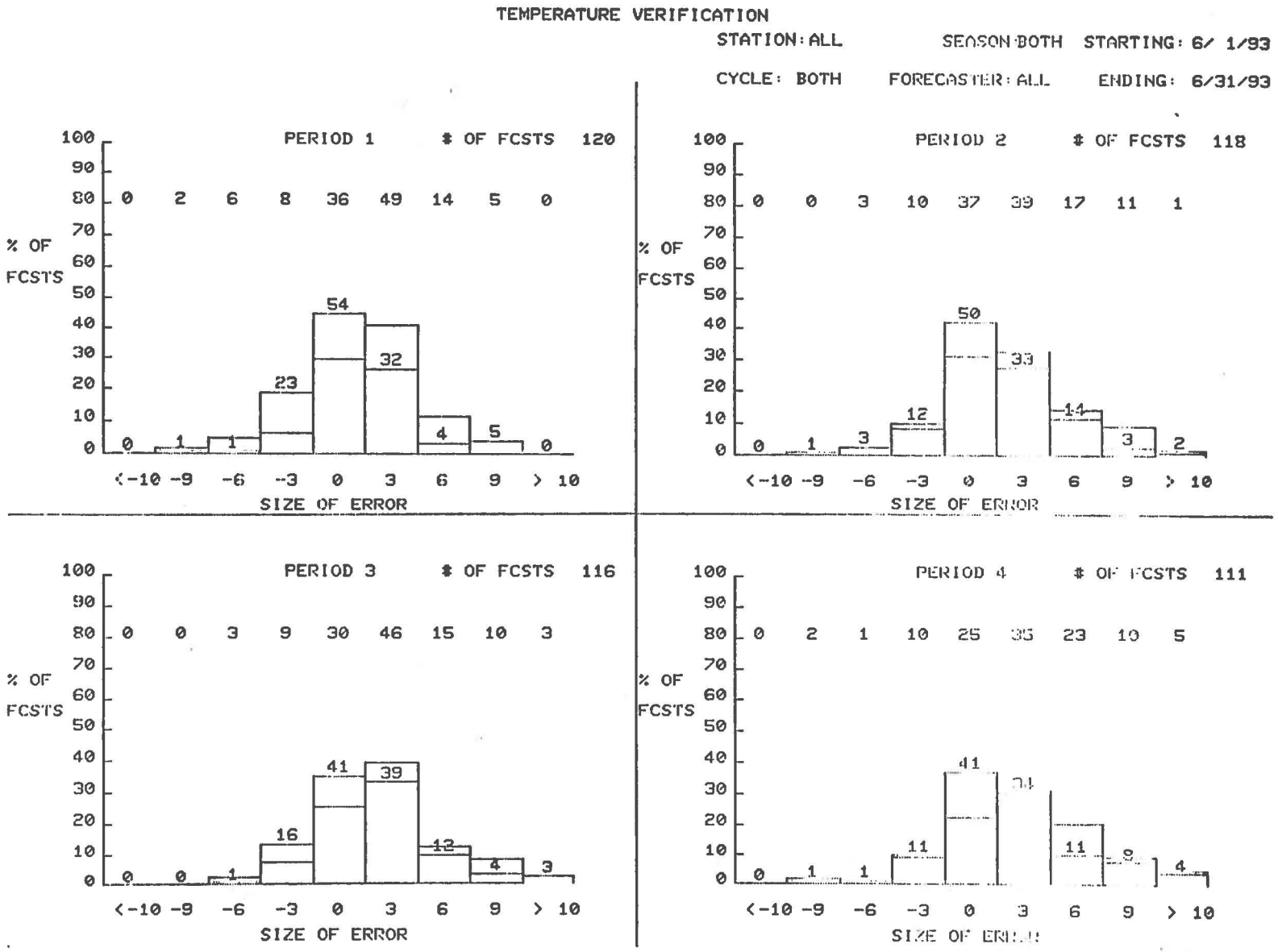


Fig. 2 Temperature Graphic - NMCGPHTEM

TEMPERATURE VERIFICATION

STATION: ALL FCSTR: ALL SEASON: BOTH PERIOD: ALL CYCLE:BOTH
FROM 6/ 1/ 93 TO 6/ 31/ 93

	1		2		3		4		ALL	
	FCSTR	MOS	FCSTR	MOS	FCSTR	MOS	FCSTR	MOS	FCSTR	MOS
# FCSTS.....	120		118		116		111		455	
MAE (DEG).....	2.3	3.0	2.6	3.4	2.8	3.6	3.2	4.1	2.7	3.5
% IMP OVR MOS.....	23.8		24.6		22.7		22.4		23.3	
MEAN ERROR (DEG)..	0.7	1.6	1.4	2.5	1.7	2.8	2.2	3.1	1.5	2.5
# CHGD GE 3..	32		38		37		32		139	
% CHGD GE 3..	26.7		32.2		31.9		28.8		29.9	
MAE CHGD GE 3..	2.2	4.1	2.6	4.6	2.9	4.6	2.7	5.3	2.6	4.6
% IMP CHGD GE 3..	47.0		43.4		37.3		47.9		43.7	
# ERR GE 6..	18		28		25		34		105	
MAE ERR GE 6..	4.9	7.6	5.3	7.4	6.0	7.8	6.8	7.9	5.9	7.7
% IMP ERR GE 6..	35.3		28.8		23.0		14.1		23.6	
# THT GE 10..	32		30		30		18		110	
MAE THT GE 10..	2.8	4.1	3.2	4.5	3.6	4.7	4.4	4.9	3.4	4.5
% IMP THT GE 10..	32.6		28.4		23.9		10.2		25.0	
% IN ERROR CLASSES										
LT-10.....	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-10 TO- 8....	0.8	1.7	0.8	0.0	0.0	0.0	0.9	1.8	0.6	0.9
- 7 TO- 5....	0.8	5.0	2.5	2.5	0.9	2.6	0.9	0.9	1.3	2.8
- 4 TO- 2....	19.2	6.7	10.2	8.5	13.8	7.8	9.9	9.0	13.3	8.0
- 1 TO 1....	45.0	30.0	42.4	31.4	35.3	25.9	36.9	22.5	40.0	27.5
2 TO 4....	26.7	40.8	28.0	33.1	33.6	39.7	30.6	31.5	29.7	36.3
5 TO 7....	3.3	11.7	11.9	14.4	10.3	12.9	9.9	20.7	8.8	14.8
8 TO 10....	4.2	4.2	2.5	9.3	3.4	8.6	7.2	9.0	4.3	7.7
GT 10.....	0.0	0.0	1.7	0.8	2.6	2.6	3.6	4.5	1.9	1.9
0- 3.....	77.5	69.2	75.4	58.5	71.6	57.8	66.7	49.5	72.9	58.9
4 - 6.....	17.5	19.2	17.8	26.3	19.8	28.4	16.2	27.9	17.8	25.4
7 - 9.....	5.0	9.2	5.1	12.7	4.3	7.8	9.9	18.0	6.0	11.8
GT 9.....	0.0	2.5	1.7	2.5	4.3	6.0	7.2	4.5	3.2	3.9
% TOO HIGH.....	54.2	65.0	58.5	72.0	62.9	79.3	64.0	72.1	59.8	72.0
% TOO LOW.....	32.5	20.8	26.3	18.6	24.1	14.7	20.7	18.0	26.0	18.1
FEDS.....	149.1		164.2		141.6		160.5		153.9	

Fig. 3 Temperature Scores - TEMPCHECK

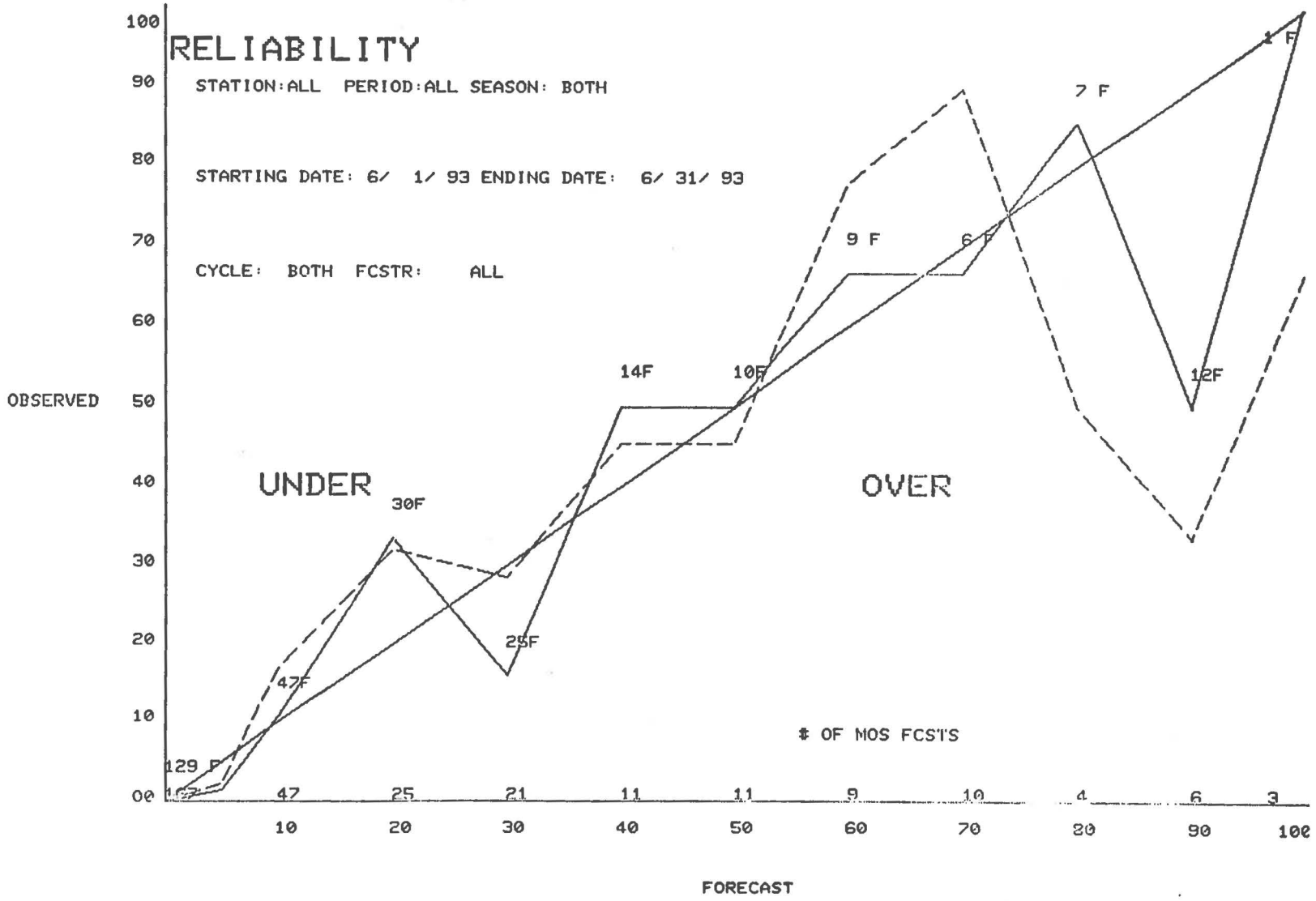


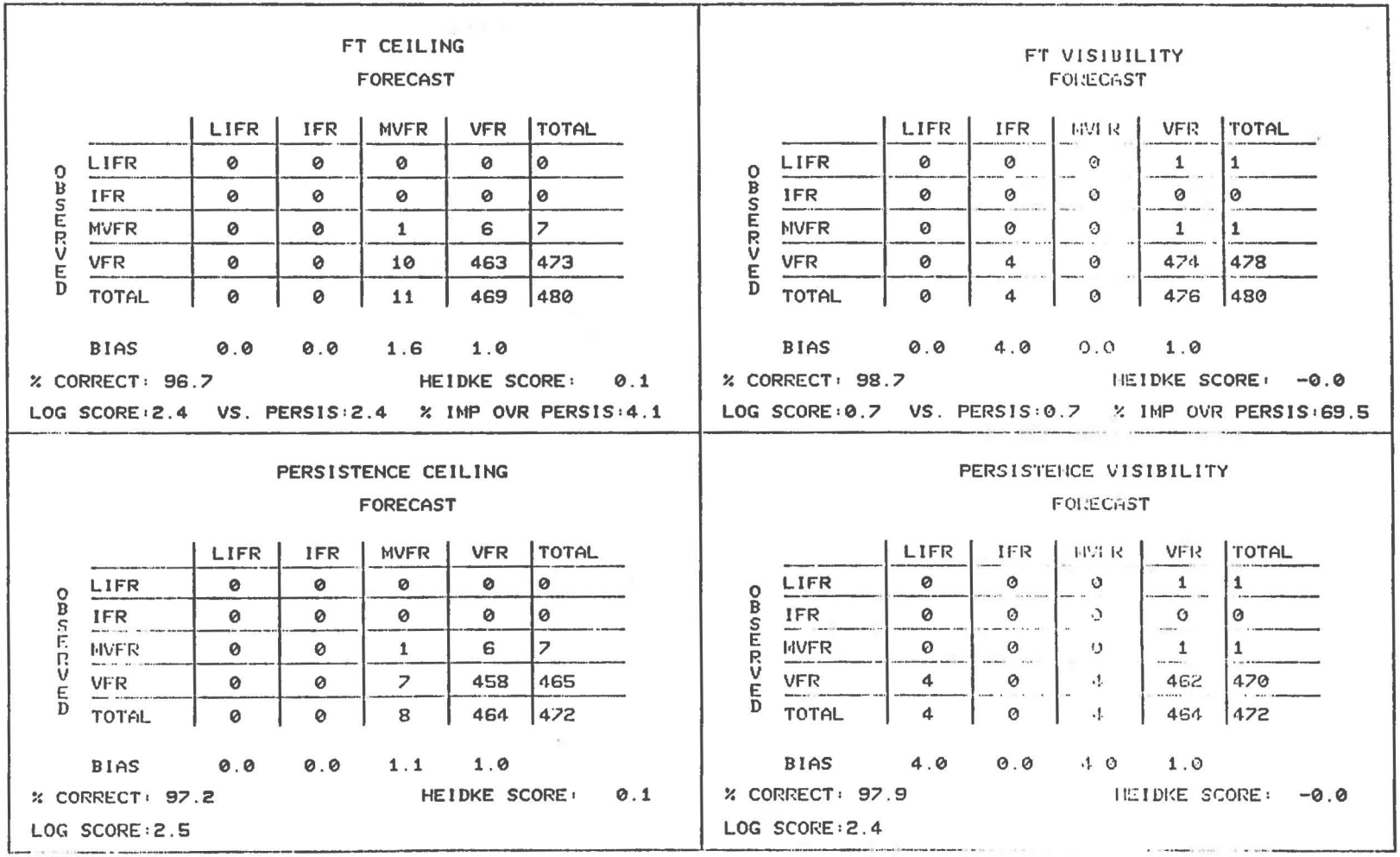
Fig. 4 Precipitation Graphic - NMCGPHREL

PRECIPITATION VERIFICATION

STATION: ALL FCSTR: ALL SEASON: BOTH PERIOD: ALL CYCLE: BOTH
FROM 6/ 1/ 93 TO 6/ 31/ 93

	1		2		3		ALL	
	FCSTR	MOS	FCSTR	MOS	FCSTR	MOS	FCSTR	MOS
# FCSTS	120		120		118		359	
# PCPN CASES	19		18		18		55	
PCPN FREQ	15.8		15.0		15.3		15.4	
MEAN POP	17.4	15.9	17.2	15.2	14.9	13.6	16.5	14.9
MEAN POP (DRY)	11.1	9.6	11.1	9.7	10.1	9.1	10.7	9.5
MEAN POP (WET)	51.1	49.5	52.2	46.1	41.9	38.6	48.5	44.8
BRIER SCORE	9.4	8.9	8.3	8.7	9.0	9.4	8.9	9.0
% IMP OVR MOS	-5.3		4.8		3.8		1.1	
# LCL POPS GE 30%..	28		29		27		84	
% IMP POPS GE 30%..	-14.1		10.3		5.6		1.3	
% IMP (WET)	5.8		13.5		7.7		8.9	
# CHGD GE 20%..	4		8		1		13	
% CHGD GE 20%..	3.3		6.7		0.8		3.6	
% IMP CHGD GE 20%..	-99.9		22.4		88.9		-7.9	
TOTAL % CORRECT ...	85.8	87.5	88.3	87.5	89.0	88.1	87.7	87.7
FEDS	-45.3		19.8		11.3		3.8	

Fig. 5 Precipitation Scores - PCPNTABLE



FT CEILING

FORECAST

OBSERVED	LIFR	IFR	MVFR	VFR	TOTAL
LIFR	0	0	0	0	0
IFR	0	0	0	0	0
MVFR	0	0	1	6	7
VFR	0	0	10	463	473
TOTAL	0	0	11	469	480
BIAS	0.0	0.0	1.6	1.0	

% CORRECT: 96.7 HEIDKE SCORE: 0.1

LOG SCORE:2.4 VS. PERSIS:2.4 % IMP OVR PERSIS:4.1

FT VISIBILITY

FORECAST

OBSERVED	LIFR	IFR	MVFR	VFR	TOTAL
LIFR	0	0	0	1	1
IFR	0	0	0	0	0
MVFR	0	0	0	1	1
VFR	0	4	0	474	478
TOTAL	0	4	0	476	480
BIAS	0.0	4.0	0.0	1.0	

% CORRECT: 98.7 HEIDKE SCORE: -0.0

LOG SCORE:0.7 VS. PERSIS:0.7 % IMP OVR PERSIS:69.5

PERSISTENCE CEILING

FORECAST

OBSERVED	LIFR	IFR	MVFR	VFR	TOTAL
LIFR	0	0	0	0	0
IFR	0	0	0	0	0
MVFR	0	0	1	6	7
VFR	0	0	7	458	465
TOTAL	0	0	8	464	472
BIAS	0.0	0.0	1.1	1.0	

% CORRECT: 97.2 HEIDKE SCORE: 0.1

LOG SCORE:2.5

PERSISTENCE VISIBILITY

FORECAST

OBSERVED	LIFR	IFR	MVFR	VFR	TOTAL
LIFR	0	0	0	1	1
IFR	0	0	0	0	0
MVFR	0	0	0	1	1
VFR	4	0	4	462	470
TOTAL	4	0	4	464	472
BIAS	4.0	0.0	4.0	1.0	

% CORRECT: 97.9 HEIDKE SCORE: -0.0

LOG SCORE:2.4

STATION:ALL PERIOD:ALL SEASON:BOTH

STARTING DATE: 6/ 1/ 93 ENDING DATE: 6/ 31/ 93

CYCLE:BOTH FORECASTER:ALL

Fig. 6 Aviation Graphic - NMCGPHAV1

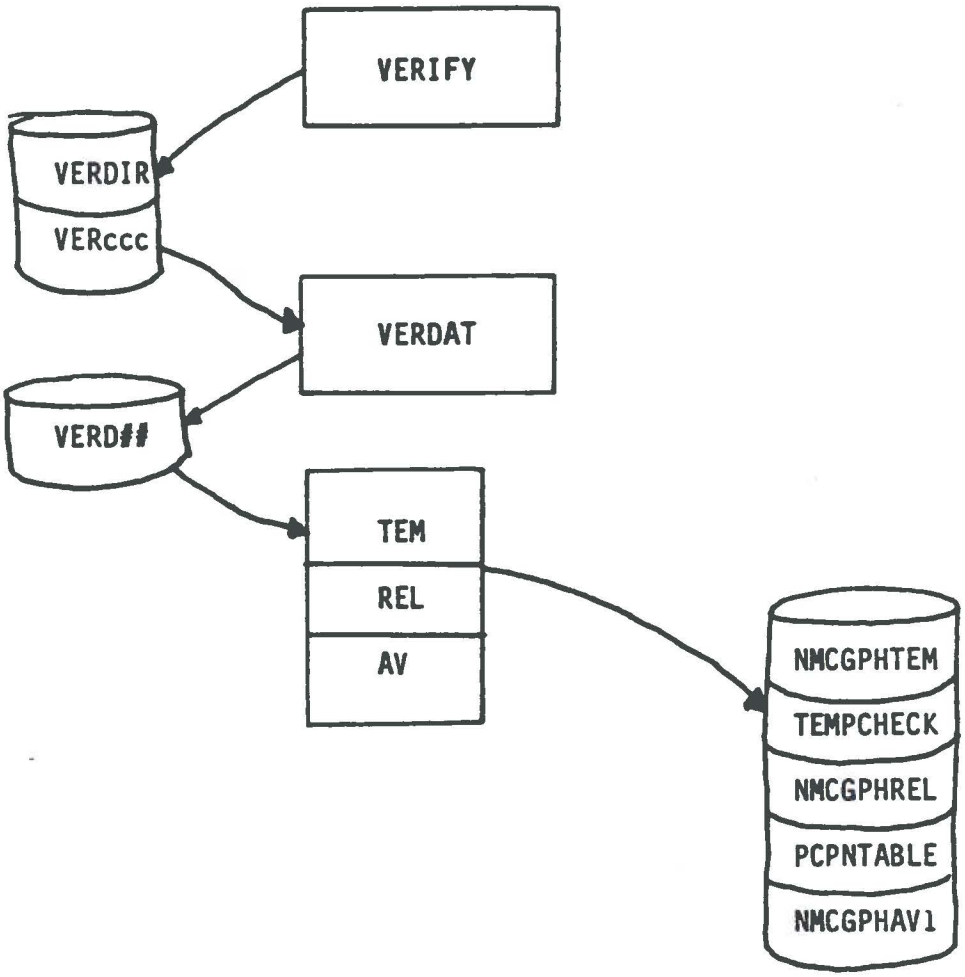
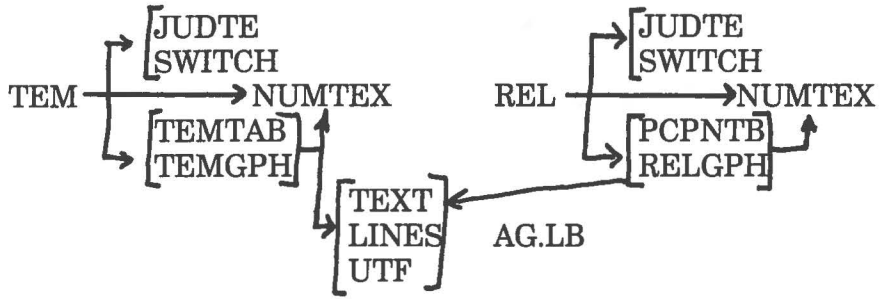
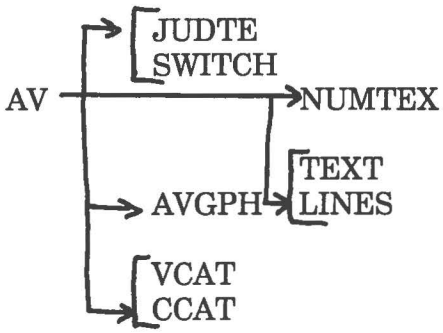


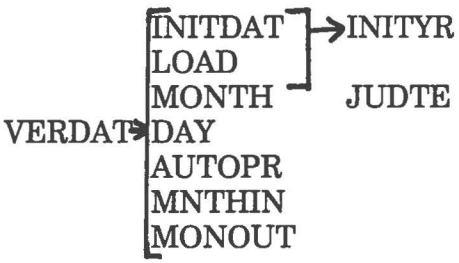
Fig. 7 Data and Program Flow Illustration

Verification Scoring Programs





Data Maintenance Program



Load lines

RLDR/N/P TEM TEMTAB TEMGPH SWITCH JUDTE NUMTEX AG.LB BG.LB UTIL.LB FORT.LB AFOSE.LB

RLDR/N/P REL PCPNTB RELGPH SWITCH JUDTE NUMTEX AG.LB BG.LB UTIL.LB FORT.LB AFOSE.LB

RLDR/N/P AV AVGPH VCAT CCAT SWITCH JUDTE NUMTEX AG.LB BG.LB UTIL.LB FORT.LB AFOSE.LB

RLDR/N/P VERDAT INITDAT LOAD MONTH DAY INITYR AUTOPR MONOUT MNTHIN JUDTE BG.LB UTIL.LB FORT.LB AFOSE.LB

Fig. 8 Software Structure and Load Lines

Local Verification Data Maintenance Program

PART A: PROGRAM INFORMATION AND INSTALLATION PROCEDURE

PROGRAM NAME: VERDAT.SV REVISION NO.: 4.0

PURPOSE: This program maintains local archive files of verification data. This data is read from the National Verification Files, VERDIR and VERccc, reformatted, and stored in the local files, VERD## (where ## is the year). Routines to initialize all or parts of these files are also included in this program.

PROGRAM INFORMATION:

Development Programmers:		Maintenance Programmer:
Larry Dunn/Warren Sunkel	Ver 1.00	Glenn Lusky - WRH/SSD
Tim Barker	Ver 3.00	
Keith Meier	Ver 4.00	

Location: WRH/SSD
Phone: 801-524-5131
Language: FORTRAN IV
Save File Creation Dates:

Original release/Rev 1.00	-	2/02/84
Second release/Rev 2.00	-	7/18/86
Third release/Rev 3.00	-	9/13/87
Fourth release/Rev 4.00	-	9/24/93

Running Time: Variable
Disk Space: Program Files - 74 RDOS Blocks

PROGRAM REQUIREMENTS:

Program Files:	Comments:
VERDAT.SV	
Data Files:	
VERccc	From AEV software
VERDIR	From AEV software
VERD##	Local verification archive

AFOS Products:
None

LOAD LINE:

RLDR/N/P VERDAT INITDAT LOAD MONTH DAY INITYR JUDTE MONOUT MNTHIN AUTOPR UTIL.LB FORT.LB AFOSE.LB

PROGRAM INSTALLATION:

1. The VERD## files should reside on USER2 and be linked to the default directory (as new files are created for new years, they are automatically created on USER2 and linked to the default directory). VERDAT.SV should also reside on the default directory or be linked to it.

Local Verification Data Maintenance Program

PART B: PROGRAM EXECUTION AND ERROR CONDITIONS

PROGRAM NAME: VERDAT.SV REVISION NO. : 4.0

PROGRAM EXECUTION:

1. VERDAT copies recent forecast verification data created by program VERIFY to a local archive file named VERD##. VERDAT also contains maintenance routines to create and initialize all or parts of the VERD## files.

2. VERDAT may be run from the Dasher or a macro. The Dasher prints a menu of options, and responses to Dasher questions control the initialization features. To allow automation of the daily data maintenance feature, VERDAT 4 may be entered in a macro or at the Dasher. The 4 indicates that option 4 (MOVE RECENT DATA FROM FILE VERccc) should be executed. Since there is no more Dasher input required for this option, VERDAT can complete this operation without operator intervention.

ERROR CONDITIONS:

The following error messages related to disk or file errors may be typed at the Dasher:

INITYR GCHN ERROR	-	Can't get an output channel
INITYR CRAND ERROR	-	Can't create new VERD## file
INITYR LINK1 ERROR	-	Can't create link from default directory to USER2
INITYR WRB ERROR	-	Can't write to VERD## file
INITYR KLOSE ERROR	-	Can't close VERD## file
ERROR OPENING YEAR	-	Can't open specified year
MONTH OUTPUT ERROR	-	Can't write to specified dates
DAY OPENN ERROR	-	Can't open output device
DAY RDB ERROR	-	Can't read data for specified date
DAY WRL ERROR	-	Can't write to specified output device
DAY WRB ERROR	-	Can't write to VERD## file
LOAD GCHN ERROR	-	Can't find open output channel
LOAD OPEN ERROR	-	Can't open specified file
LOAD RDS ERROR	-	Can't read specified file
LOAD RDB ERROR	-	Can't read specified file
LOAD WRB ERROR	-	Can't write to VERD## file
LOAD KLOSE ERROR	-	Can't close VERD## file

Local Verification Scoring Programs

PART A: PROGRAM INFORMATION AND INSTALLATION PROCEDURE

PROGRAM NAME: TEM.SV, REL.SV, AV.SV REVISION NO.: 4.0

PURPOSE: These programs calculate verification scores and statistics based on data in the VERD## files. TEM.SV calculates temperature verification scores and statistics. REL.SV calculates precipitation verification scores and statistics. AV.SV calculates ceiling and visibility scores and statistics.

PROGRAM INFROMATION:

Development Programmers:
Larry Dunn Rev. 1.00
Tim Barker Rev. 3.00
Keith Meier Rev. 4.00

Maintenance Programer:
Glenn Lusky - WRH/SSD

Location: WRH/SSD
Phone: 801-524-5131
Language: FORTRAN IV
Save File Creation Dates:

Original Release/Rev. 1.00	-	03/11/85
Second Release/Rev. 2.01	-	09/12/86
Third Release/Rev. 3.01	-	09/13/87
Fourth Release/Rev. 4.00	-	09/22/93 (AV.SV) 09/23/93 (REL.SV) 09/27/93 (TEM.SV)

Running Time: Variable

Disk Space:	TEM.SV	-	101 RDOS blocks
	REL.SV	-	86 RDOS blocks
	AV.SV	-	61 RDOS blocks

PROGRAM REQUIREMENTS:

Program Files:

Name:	Comments:
TEM.SV	Temperature Verification
REL.SV	Precipitation Verification
AV.SV	Aviation Verification

Data Files:

Name:	Action:	Comments:
VERD##	Read	Produced by VERDAT program

AFOS Products:

ID:	Action:	Comments:
NMCGPHTEM	STORED	Temperature Graphic
TEMPCHECK	STORED	Temperature Alphanumeric

NMCGPHREL	STORED	Precipitation Graphic
PCPNTABLE	STORED	Precipitation Alphanumeric
NMCGPHAV1	STORED	Aviation Graphic

LOAD LINES:

RLDR/N/P TEM TEMTAB TEMGPH SWITCH JUDTE NUMTEX AG.LB BG.LB UTIL.LB FORT.LB AFOSE.LB

RLDR/N/P REL PCPNTB RELGPH SWITCH JUDTE NUMTEX AG.LB BG.LB UTIL.LB FORT.LB AFOSE.LB

RLDR/N/P AV AVGPH VCAT CCAT SWITCH JUDTE NUMTEX AG.LB BG.LB UTIL.LB FORT.LB AFOSE.LB

PROGRAM INSTALLATION:

1. TEM.SV, REL.SV, and AV.SV should reside on the default directory or be linked to it.

2. The VERD## files should reside on USER2 and should be linked to the default directory.

3. The special map backgrounds should be added to the database, and stored to the database from the program diskette. The backgrounds are stored on the diskette under the names TEMBACK (temperature background), RELBACK (precipitation background), and AVBACK (aviation background). **NOTE: Both TEMBACK and AVBACK are new backgrounds, and must be stored for this version of the Local AEV software.**

4. The AFOS products should be added to the database and the appropriate backgrounds keyed to the graphic products.

Local Verification Scoring Programs

PART B: PROGRAM EXECUTION AND ERROR CONDITIONS

PROGRAM NAMES: TEM.SV, REL.SV, AV.SV REVISION NO.:4.0

PROGRAM EXECUTION:

1. These programs calculate and display verification scores and statistics for both local and MOS forecasts. TEM.SV verifies temperature forecasts; REL.SV verifies precipitation forecasts; AV.SV verifies ceiling and visibility forecasts. Scores and statistics can be calculated over several years, for a specific forecaster, station, forecast period and cycle. the statistics can also be calculated only using warm or cool season data, if desired. The command line switches specify the verification criteria to be used.

   RUN: (TEM or REL or AV) (switches in any order)

2. The switches are all optional and are defined as follows:

XXX/L	Station	AFOS 3 letter station ID. Default is all stations
#/P	Period	Valid periods: 1-6 for TEM and AV; 1-3, 5, and 6 for REL. Default is all periods.
#/F	Forecaster #	Valid numbers: 1-99. Default is all forecasters.
######/S	Starting Date	Any valid date in MMDDYY format. MM is the month, DD is the date, and YY is the year. Default is six months prior to the current date.
######/E	Ending Date	Any valid date in MMDDYY format. MM is the month, DD is the date, and YY is the year. Default is six months prior to the current date.
#/C	Cycle	Valid cycles: 0 and 12. Default is both cycles.
#/N	Season	Valid seasons: 1 ("cool" season: Oct 1 - Mar 31) or 2 ("warm" season: Apr 1 - Sep 30). Default is both seasons. This does not change the default starting and ending dates. Only those forecasts made on days that satisfy <u>both</u> the date switches <u>and</u> the season switch are considered (see examples).
#/W	Error Class Width	Valid numbers: Odd numbers 1-9.
#/M	MOS Changed By	Valid numbers: 1-99.
#/A	MOS/Local error >	Valid numbers: 1-99.
#/T	Threat of Chg >	Valid numbers: 1-99.
#/X	Verify using MOS	Valid numbers: 0 and 1. To score versus persistence set switch to 0. Default is 1, which scores versus MOS.
#/D	Use list of dates	Valid numbers: 0 and 1. To use a file containing a list of forecast dates (LODS.) set switch to 1. Default is 0, which **does not** look for a file containing a list of forecast dates.

EXAMPLES:

RUN:TEM 010192/S 123193/E	Calculates temperature scores for all periods, stations, cycles, and forecasters from 1 Jan 1992 to 31 Dec 1993, scoring versus MOS.
RUN:AV 010192/S 123192/E 2/N	Calculates aviation scores for all periods, stations, cycles, and forecasters from 1 Apr 1992 to 31 Sep 1992.
RUN:REL 010192/S 123193/E 2/N	Calculates precipitation scores for all periods, stations, cycles, and forecasters from 1 Apr 1992 to 31 Sep 1992 and 1 Apr 1993 to 31 Sep 1993.
RUN:TEM 010193/S 033193/E 2/N	No scores are calculated because there are no dates that satisfy both the date and the season switches.
RUN:AV 21/F 12/C SLC/L	Calculates aviation statistics for the last six months of 12z forecasts made by forecaster #21 for SLC.
RUN:TEM 0/X 1/D	Calculates temperature statistics for all stations, periods, cycles, and forecasters using the files containing the list of forecast dates (LODS.) and scoring versus persistence rather than MOS.

Complete Installation Procedure

Initialize the USER2 partition, if necessary, so that the system will recognize the partition. This should be edited into the AFOS macro.

Insert the program floppy and direct the system to that floppy drive.

Move TEM.SV, REL.SV, AV.SV, and VERDAT.SV from the floppy to the default directory.

> If you are updating from version 3.0 to 4.0, simply replace these existing programs with the new programs.

Add the special map backgrounds to the AFOS database with either the WISHLIST or a PILEDIT.

Store the map backgrounds from the floppy into the AFOS database using the background numbers you just added. The backgrounds are stored on the diskette as TEMBACK, RELBACK, and AV1BACK (**NOTE: Backgrounds TEMBACK and AV1BACK are new**)

> If you are updating from version 3.0 to 4.0, simply replace the existing backgrounds with the new backgrounds (TEMBACK and AV1BACK) using the background numbers previously used.

Add the following products to the AFOS database with either the WISHLIST or a PILEDIT:

NMCGPHTEM	Temperature verification graphic
TEMPCHECK	Temperature verification table
NMCGPHREL	Precipitation verification graphic
PCPNTABLE	Precipitation verification table
NMCGPHAV1	Aviation verification graphic

Key the appropriate backgrounds to the new AFOS products NMCGPHTEM, NMCGPHREL, and NMCGPHAV1.

Check that the National Verification Files, VERccc and VERDIR, reside on the default directory or are linked to it.

The system is now ready to run. VERDAT (option 4) should be run daily (after VERIFY is run) to update the verification data. The verification scoring programs may be run at any time.