NOAA Techniques Development Laboratory
Computer Program NWS TDL CP 83-4

AFOS MONITORING OF TERMINAL FORECASTS

Silver Spring, Md.
December 1983

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

PREFACE

The Techniques Development Laboratory's (TDL's) computer program (CP) series is a subset of the Lab's technical memorandum series. The CP series documents computer programs written at TDL primarily for the Automation of Field Operations and Services (AFOS) computers.

The format for the series follows that given in the AFOS Reference Handbook, Volume 6, Background Applications.

NOAA Techniques Development Laboratory
Computer Program NWS TDL

CP 83-1 Cross Sectional Analysis of Wind Speed and Richardson Number. Gilhousen, Kemper, and Vercelli, May 1983. (PB83 205062)

CP 83-2 Simulation of Spilled Oil Behavior in Bays and Coastal Waters. Hess, October 1983. (PB84 122597)

CP 83-3 AFOS-ERA Forecast Verification. Heffernan, Newton, and Miller, October 1983.

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David J. Vercelli

1. INTRODUCTION

Three times each day meteorologists at Weather Service Forecast Offices (WSFO's) issue terminal forecasts (FT's) for each of a selected number of terminals within the area of responsibility of the WSFO. The meteorological information contained in the FT's is that considered to be of most importance to aviation interests in and near the terminal area. The FT consists of forecasts of cloud height, cloud amount, visibility, weather, wind speed, and wind direction. Following issuance of the FT's, the meteorologist must continually monitor them to ensure that they adequately reflect current weather conditions.

With the advent of the Automation of Field Operations and Services (AFOS), the means are available to aid the forecaster in the time consuming task of monitoring the FT's. A computer program described by this document will, upon forecaster initiation, compare the meteorological elements of incoming surface airway observations (SAO's) and the corresponding forecasted elements in the FT's with the official FT amendment criteria (NWS, 1983) and a set of alert criteria. If the program detects a problem with one or more of the FT's, a locally stored product will be generated and either the audio alarm and alarm light or the alarm light only will be activated at the alphanumeric display module (ADM) to signify program completion. If no problems are detected, no product will be generated and no alarm will be activated.

Activation of the audio alarm and alarm light signifies that at least one FT requires amendment. In this case, the xxx portion of the cccnnnxxx product identification will be set to AMD for amendment. Activation of the alarm light alone signifies that, although no FT's require amendment, one or more may require amendment in the near future due to changing weather conditions, an SAO or FT decoding error prevented monitoring of an FT, or a combination of both has occurred. Here, the xxx portion of the cccnnnxxx will be set to ALT for alert. In both the AMD and ALT cases, the output product will give specific information on the problem terminals and a general summary for the remaining terminals. Also, to display either the AMD or ALT product once the alarm has been activated, the forecaster need only press the alarm light button on the ADM keyboard.

Upon completion of the monitoring program, called MONITR, the forecaster can, if desired, get an updated guidance forecast for each of the stations for which an amendment is required or may be required. This is done by executing the Generalized Exponential Markov (GEM) applications program (Herrmann, 1983). The GEM program will read the call letters of the problem stations from an RDOS disk file created by the MONITR program.

2. METHODOLOGY AND SOFTWARE STRUCTURE

Fig. 1 illustrates the data flow and program relationships in the monitoring system. The first program, MONITRSD, is an interactive program used to create

an RDOS disk file (MONITR.D1) containing necessary station information such as the call letters of the monitored terminals. This program will normally be run only once at a WSFO. It is not needed again unless the disk file is damaged or destroyed, or the stations to be monitored are changed. The software structure and load line for MONITRSD are shown in Fig. 2.

The directory, MONITR.D1, consists of one record of three words followed by one nine-word record for each station to be monitored. The file structure and contents are shown in Table 1. The first two words of record 1 contain the left-justified call letters of the WSFO running the MONITR program. The third word contains the total number of stations to be monitored. Words 1 and 2 are entered by the user. Word 3 will be filled in by the program after the user has completed data entry. For the nine-word records, only the first four words must be entered by the user for each station. Words 1 and 2, together, contain the call letters of the monitored station's parent WSFO. This is followed, in words 3 and 4, by the call letters of the station to be monitored. Each pair of words must be left-justified upon entry. Words 5 through 9, inclusive, contain time information, obtained from the SAO's used during the last execution of the MONITR program. These words are initialized to zero by MONITRSD and are then updated from that time forward with each run of MONITR.

MONITR, the second program shown in Fig. 1, performs the actual monitoring of the FT's. The software structure and load line for MONITR are shown in Fig. 2. The main program relies on five primary subroutines to do the work. They, in turn, make use of a number of additional subordinate subroutines, as indicated in the figure. The operation of each of the five primary subroutines is discussed next.

A. Subroutine BLDSAO

BLDSAO, the first of the five primary subroutines, is responsible for building an array of decoded SAO's for the stations to be monitored. The first step in the process is to read the station information contained in the MONITR.D1 file. This is done by a call to subroutine RDSDIR.

Four subroutines are then called sequentially by BLDSAO for each station to be monitored. The first subroutine, GETPRD, builds the product key in the form cccSAOxxx, where ccc is the monitored station's parent WSFO and xxx is the monitored station. A key search is then performed for the SAO product, and, if it is found, it is stored in a temporary array. Otherwise, the station is flagged and is not monitored during this run of the program.

Once an SAO is retrieved for a particular station, subroutine TIMCOM verifies that it is a more recent observation than that last used for the station. It does this by computing the total elapsed minutes since the beginning of the year from the SAO communications header and comparing that to the corresponding time retrieved from MONITR.D1 (words 6 and 7, Table 1). For a more recent SAO, subroutine AIRDX (Thomas, 1981; Rev No. 02.00) is used to decode it; otherwise, the station is flagged and not monitored.

Subroutine PRDTIM is used to determine the valid time of each SAO. If the SAO is a special, then the time the observation was taken by the observer is

the valid time and it is obtained directly from the decoded SAO. For record or record special observations, however, the valid time is usually not the same as the time the observation was taken. PRDTIM will make this determination and then set the appropriate valid time. For example, say a record observation was taken at 0957 GMT. Since it was a record observation, the valid time is actually 1000 GMT. Therefore, 1000 GMT would be used by MONITR. Obtaining the valid SAO time is necessary to ensure that the proper FT sentence is examined later in the program.

If no errors have been detected, BLDSAO adds this observation to an array of similarly decoded SAO's. This process, beginning with GETPRD, continues until all of the stations to be monitored have been decoded or flagged.

Finally, BLDSAO calls UPSDIR to update MONITR.D1 with the valid times of the successfully decoded SAO's. The stations which were flagged due to errors are not updated.

B. Subroutine BLDFT

For each station for which a new SAO was found, BLDFT will attempt to retrieve a corresponding FT from the AFOS database. As before, subroutine GETPRD is used to build the product key. This time it is in the form cccFTAxxx. A key search is done and, if it is found, the FT is stored in a temporary array. Otherwise, the station is flagged and not monitored. When an FT is retrieved, it is decoded by subroutine DCDFT (Heffernan, 1982). Subroutine FTSATM then verifies that the SAO time for this station falls within the valid period of the FT. If this is confirmed by FTSATM, subroutine FNDGRP extracts the FT sentence which is currently valid and saves it in a temporary array.

The last task performed by BLDFT is to add the extracted sentence to an array of decoded FT sentences. It is this decoded FT array and the decoded SAO array that are used by subroutine COMPAR in performing the monitoring function.

C. Subroutine COMPAR

Subroutine COMPAR determines whether or not an FT amendment is required. It does this by comparing corresponding variables in the FT and the SAO with the official FT amendment criteria and a set of alert criteria. The alert criteria were developed to provide warning that, although an amendment is not required at present, weather conditions indicate an amendment may be required in the near future. Both the amendment and alert criteria for each of the monitored forecast elements are shown in Table 2.

COMPAR's first task is to determine the criterion number for each of the monitored forecast elements. For example, an FT ceiling forecast of 2000 feet is equivalent to ceiling criterion number 3 in Table 2. These determinations are made by subroutine FCST (called by COMPAR) and its subordinate subroutines. The subordinate subroutines--FCIG, FVIS, and FWND--are used to categorize the forecast values for ceiling, visibility, and wind, respectively, while FWX is used for both hazardous precipitation and thunderstorms. Subroutine FRMK extracts the remarks section of the FT sentence for display purposes only.

Once the forecast criterion numbers have been determined for each element and each station, COMPAR passes the information to subroutine AMDALT. Initially, it is assumed that each FT is valid. AMDALT compares the SAO value for each monitored element with the amendment and alert criteria corresponding to the FT forecast criterion number for that element. Subroutines AMDCIG, AMDVIS, AMDWND, and AMDDIR are used to determine if an amendment is required for ceiling, visibility, wind speed, or wind direction, respectively. If an amendment is not required for a particular element, the corresponding alert subroutine (ALTCIG, ALTVIS, ALTWND, and/or ALTDIR) is called to check if an alert is required. For hazardous precipitation and thunderstorms, AMALWX is used for both amendment and alert determinations.

A flag is set for each element for which an amendment or an alert is required. For example, suppose an SAO had a reported ceiling of 2000 feet and a visibility of 4 miles. If the corresponding FT had a forecasted ceiling of 6000 feet (ceiling criterion 2) and an 8 mile visibility (visibility criterion 1) then ceiling would be flagged as requiring an amendment while the visibility would be flagged as requiring an alert (see Table 2).

The amendment and alert criteria for hazardous precipitation and thunderstorms require knowledge of the starting hour of the valid forecast period. If the element is forecasted to occur but has not occurred within 2 hours (1 hour) of the start of the valid period, an amendment (alert) flag will be set for that element. For example, suppose an FT forecast period is from 10Z to 17Z and freezing rain is forecast. If at 11Z (12Z) freezing rain is not reported in the SAO, an alert (amendment) flag will be set.

Once all of the comparisons have been completed for all the stations, the MONITR program begins to build its display product to be stored in the AFOS database. This is accomplished by subroutine DSPLAY and its subordinate routines.

D. Subroutine DSPLAY

Subroutine DSPLAY produces the output display detailing the results of the comparisons done by the monitoring program. DSPLAY first creates an RDOS disk file entry with the name cccTAPxxx, where ccc is the call letters of the station executing the MONITR program (obtained from record 1 in MONITR.D1, Table 1) and xxx is either AMD or ALT depending on the nature of the problem.

Once the file is created, subroutine HEADNG builds the communications header and stores it in the file. Subroutine MESSAG is then used by DSPLAY to format the output results. An example of the output display is shown in Fig. 3.

Each of the MESSAG subordinate subroutines serves a specific purpose. The first, COLHDR, is used to build the column headings for the output product. A counter is used in the program to determine when a new page has been started and, therefore, when COLHDR must be called again.

Once the column headings have been written out, an array containing the information for one element for one station is built and then written out to the file. First, MESSAG inserts the station's call letters. It then calls several other subroutines which complete the building of the output product.

ALRMTY is used to add the "AMEND", "ALERT", or "?", as required, to the AMEND/ALERT column. The "?" is used in those cases where monitoring of a particular element could not be done due to missing data or decoding errors. The name of the meteorological variable for which an amendment or alert is required (or for which an error was detected) is inserted into the array by subroutine ELEMNT. Subroutine PRTVAL is then called to add the forecast and observed ceiling, visibility, wind speed, and wind direction values to the array, while PRTWX inserts the hazardous precipitation and thunderstorm characters (FORECAST and OBSERVED columns in Fig. 3). The information contained in the last column of Fig. 3 is composed by subroutine CRITRN for the ceiling, visibility, and wind elements, and by WXCRIT for the hazardous precipitation and thunderstorms. The last task to be done for each problem station is for subroutine REMARK to write out the FT remark.

MESSAG then builds the display summarizing the remaining stations. It does this by calling subroutine STNLST which identifies those stations where monitoring is not possible due to missing SAO's or FT's, decoding errors, and/or SAO's not containing any new information. STNLST will also determine those stations for which no FT amendment or alert was required. STNLST will insert the proper headings and error messages and then call subroutine WRTLST to add the call letters to the display.

Once the output product is built, it is stored in the AFOS database through a call to FSTOR. The RDOS copy will remain until the next time the program is run. At that time, it will be deleted prior to creation of the new file. MONITR will never leave more than one redundant copy of the AFOS product as an RDOS file.

E. Subroutine GEMLST

Subroutine GEMLST creates an RDOS disk file called MONITR.D2. It then writes out the call letters for those terminals where either an amendment or an alert was indicated. This file is then used by the GEM applications program (Herrmann, 1983) to produce updated guidance forecasts of the surface observed weather elements for each problem terminal.

3. PROCEDURES

A. MONITRSD

To load the station call letters into the MONITR.D1 file, enter:

```
MONITRSD
```

at the Dasher. The program will prompt the user for data entry. First, the user will enter the left-justified call letters of the WSFO running both this program and the MONITR program. This will be followed by entry of the ccc xxx of each station for which FT monitoring is desired. Here, xxx is the call letters of the station to be monitored and ccc is the call letters of the monitored station's parent WSFO. The space between the ccc and the xxx is required.

The MONITRSD program was written to allow some limited editing of the call letters prior to them being written to the RDOS disk file. The user will be prompted by the program for responses to its questions. Stations can be added, deleted, and corrected.

MONITRSD allows for a maximum of 25 FT's to be monitored (i.e., 25 xxx's may be entered). The program requires 9K words of storage for execution.

B. MONITR

The MONITR output will be stored in the AFOS database under one of two product identifications. These are cccTAPAMD and cccTAPALT, where ccc is the initiating station's call letters. The user should ensure that both products are in the AFOS product inventory list (PIL) or in the WISH list. The alarm characteristics for the products should be set as follows:

Product	Alarm Characteristic
1) cccTAPAMD	audio alarm and alarm light
2) cccTAPALT	alarm light only

Initiation of the monitoring program is done by entering:

RUN:MONITR

at the ADM console.

MONITR runs in 32K words and takes about 40 seconds to execute for 12 stations. Input consists of the MONITR.D1 file and the SAO's and FT's from the AFOS database. The output will be stored in cccTAPxxx where ccc is the initiating station's call letters, which were stored as the first two words of record 1 in MONITR.D1 and xxx will be either AMD or ALT as determined by the program.

Program completion will be signified by activation of the audio alarm and alarm light if one or more stations require FT amendment. Here, the product will be stored as cccTAPAMD. The alarm light alone will be activated when no FT's require amendment but one or more may require amendment in the near future (i.e., an alert), or an SAO or FT decoding error prevented monitoring of an FT, or a combination of the above has occurred. The product will be stored as cccTAPALT. To display either the cccTAPAMD or cccTAPALT products, the forecaster need only depress the alarm light button. If no problems are detected with any of the FT's or no new information has been received since the last time the program was run, no alarms will be activated at the ADM.

4. CAUTIONS

Currently, the FT decoder does not examine the remarks section of the FT. As a result, MONITR will operate on the conservative side by triggering both amendment and alert messages more frequently than it would if the remarks were taken into consideration. The MONITR program is being modified to use the FT remarks information and it will be issued as a new version of the program when

the work has been completed. This paper will also be updated at that time to reflect the changes.

Monitoring will be done on all available data. However, the forecaster should be aware that forecaster monitoring of the FT may be advisable when data are missing. This is especially true if other variables for a particular station require amendment or may require amendment shortly. Missing data, or errors detected while decoding individual elements in the FT's and SAO's, are flagged within the program and will be indicated in the output display for the user's information.

There are two possible causes for an FT not being monitored at all. The first would be because either the SAO or the FT was not found in the AFOS database. The second possibility is that the product was found but could not be decoded at all. The call letters of any station meeting one of these criteria will be listed along with an appropriate message in the output product.

Finally, the call letters of the stations for which no problems with the FT were detected or for which the information contained in the SAO had not changed since the last time the program was run are listed with a message to that effect. This is included as a check for the user that the program is examining all the FT's. Note, however, that this information will only be provided to the user when either a cccTAPAMD or cccTAPALT product has been generated.

5. REFERENCES

Heffernan, M. M., 1982: (unpublished documentation).

Herrmann, W. C., 1983: Generalized Exponential Markov (GEM) Updating Procedure for AFOS. NOAA Techniques Development Laboratory Computer Programs NWS TDL CP 83-5, National Weather Service, NOAA, U.S. Department of Commerce, (in preparation).

National Weather Service, 1983: Aviation Terminal Forecasts. National Weather Service Operations Manual, Chapter D-21, Manual Issuance 83-14, NOAA, U.S. Department of Commerce, 41 pp.

Thomas, R. D., 1981: Surface Airways Observation Decoder. Unpublished manuscript, National Meteorological Center, National Weather Service, NOAA, U.S. Department of Commerce, 22 pp.

6. PROGRAM INFORMATION and PROCEDURES for INSTALLATION and EXECUTION

AFOS MONITORING OF TERMINAL FORECASTS

PART A: PROGRAM INFORMATION and INSTALLATION PROCEDURE

PROGRAM NAME: MONITR

AAL ID: DBC009
Revision No.: 01.00

FUNCTION: Compares terminal forecasts (FT's) and surface airway observations (SAO's) with amendment and alert criteria and informs user when FT needs or may need amendment. Creates a local use alphanumeric product stored on DPO and also in the AFOS database.

PROGRAM INFORMATION:

Development Programmer(s):	Maintenance Programmer(s):
David J. Vercelli	David J. Vercelli
Location: Techniques Development Laboratory	Location: Techniques Development Laboratory
Phone: FTS - 427-7639	Phone: FTS - 427-7639
Language: FORTRAN IV/ Rev 5.20	Type: Overlay
Save file creation dates: MONITRSD.SV	
Original release/ Rev 01.00 -	October 6, 1983
Running time: Variable -	user interactive program
Disk space: Program files -	23 RDOS blocks
Data files -	1 RDOS block
Save file creation dates: MONITR.SV	
Original release/ Rev 01.00 -	November 22, 1983
Running time: About 40 seconds	
Disk space: Program files -	158 RDOS blocks
Data files -	2 RDOS blocks

PROGRAM REQUIREMENTS

Program files:

NAME	COMMENTS
MONITRSD.SV	Program creates MONITR station directory.
MONITR.SV	
MONITR.OL	

Data files:

NAME	DP location	READ/WRITE	COMMENTS
MONITR.D1	DPOF	R/W	Created by MONITRSD, accessed and updated by MONITR.
MONITR.D2	DPOF	W	Input to GEM (AAL ID: MOHO08).
cccTAPAMD	DPO	W	
cccTAPALT	DPO	W	

AFOS Products:

ID	ACTION	COMMENTS
cccTAPAMD	Stored	The ccc is the executing WSFO node.
cccTAPALT	Stored	

LOAD LINE

```
MONITRSD:  RLDR MONITRSD BG.LB UTIL.LB FORT.LB
MONITR:    RLDR MONITR GETPRD CKEY AFDTIM DCMPR TIMCOM CRITRN GEMLST
           MESSAG AIRDX PRDTIM STNLST
           [BLDFT DCDFT GETRMK CLD COUNT SSEARCH VSBLTY WTHR FTSATM FNDGRP,
           BLDSAO RDSDIR UPSDIR ANDEQ ANDGO NUMBR ORGO
           COMPAR FCST AMDALT FCIG FVIS FWND FWX FRMK AMDCIG ALTCIG
           AMDVIS ALTVIS AMDWND ALTWND AMDDIR ALTDIR AMALWX, DSPLAY HEADNG
           REMARK CONVERT COLHDR SPACER
           ALRMTY ELEMNT PRTVAL PRTWX WXCRIT WRTLST]
           BG.LB UTIL.LB FORT.LB
```

PROGRAM INSTALLATION:

1. Move MONITRSD.SV, MONITR.SV, and MONITR.OL to DPOF. Create links in DPO to MONITRSD.SV, MONITR.SV, MONITR.OL, MONITR.D1, and MONITR.D2 on DPOF.

2. MONITRSD must be run prior to running MONITR for the first time. MONITRSD creates the MONITR.D1 data file which is used and updated by MONITR from then on.

3. Make sure the cccTAPAMD and cccTAPALT keys for the output alphanumeric products are in the PIL. The audio alarm must be set for the cccTAPAMD product and the light alarm set for the cccTAPALT product, where ccc is the executing WSFO node.

AFOS MONITORING OF TERMINAL FORECASTS

PART B: PROGRAM EXECUTION and ERROR CONDITIONS

PROGRAM NAME: MONITR

AAL ID: DBC009
Revision No.: 01.00

PROGRAM EXECUTION

1. Run the station directory program, MONITRSD, at the Dasher. Program will prompt user for data entry.
[NOTE: MONITRSD.SV can be deleted from DPOF and unlinked from DPO once the MONITR.D1 file has been created. This program will only be needed again if MONITR.D1 has been destroyed or the terminals to be monitored by MONITR are changed.]

2. From an ADM, enter: RUN:MONITR

   The audio alarm and alarm light will be activated to signify program completion if one or more FT's need amendment. The product will be stored in the AFOS database as cccTAPAMD, where ccc is the executing WSFO node. The alarm light will be activated when one or more FT's may require amendment in the near future due to changing weather conditions (although none require it now), an SAO or FT decoding error prevented monitoring of an FT, or a combination of the above occurs. In this case, the product will be stored as cccTAPALT, where ccc is as defined above. For both the cccTAPAMD and cccTAPALT alarms, the user need only depress the alarm light button to display the product. If no problems were detected with any of the monitored FT's, no product will be generated and no alarm will be activated.

   MONITR will delete the RDOS copy of the AFOS database product (either cccTAPAMD or cccTAPALT) upon the next running of the program. This way no more than one RDOS copy will ever be left on DPO. The RDOS copy can also be manually deleted.

ERROR CONDITIONS

Error conditions other than those listed here, appearing at the Dasher, denote problems that occur while accessing files, most likely caused by system/disk problems rather than program failures. Check the RDOS error code and rerun MONITR if appropriate.

ADM MESSAGES	MEANING
1- "JOB MONITR ABORTED--ERROR CONDITION: SEE DASHER"	This message will be displayed only if MONITR could not run at all. For example, Dasher messages 1 and 2 (shown below) will not stop the program while message 3 will stop it and cause this ADM message to be displayed.

DASHER MESSAGES	COMMENTS
1- "GETPRD KSRCF ERR = # STATION cccxxx SKIPPED DUE TO ERR"	A key search, done in subroutine GETPRD, for an AFOS database product (either SAO or FTA) was not successful. Generally, it indicates that a current product was not available. Check the spelling of the ccc and xxx as printed to ensure correctness. If they are not correct, rerun the MONITRSD.SV program and correct them. If they are correct, the program will monitor the station once a current FT or SAO has been stored in the database.
2- "GETPRD RDBKF ERR = # STATION cccxxx SKIPPED DUE TO ERR"	This indicates that the product key was found but there was an error while trying to read the data. Product is skipped for this run of the program.
3- "RDSDIR OPENN ERR: MONITR.D1 (STN DIR) = 13 MONITR BG.LB FORKE ERR = 0"	Check that the MONITR.D1 file is on DPOF and that the link has been created on DPO. MONITR will not run until this has been corrected.

Table 1. Format of MONITR.D1 RDOS disk file.

Words	Contents	Variable Type
Record 1		
1-2	Call letters (left-justified) of station initiating MONITR program (e.g., WBC)	Packed ASCII
3	Total number of stations to be monitored	Integer
	The following 9 words are repeated for each station to be monitored.	
Records 2-N		
1-2	Call letters (left-justified) of monitored station's parent WSFO (e.g., WBC)	Packed ASCII
3-4	Call letters (left-justified) of station to be monitored (e.g., DCA)	Packed ASCII
5	Year (e.g., 1983)	Integer
6-7	Both words combined contain total elapsed minutes since beginning of year	Integer
8	Day of month	Integer
9	SAO product time (hhmm GMT)	Integer

Table 2. FT amendment and alert criteria for ceiling (cig), visibility (vis), wind speed (spd), wind direction (dir), and weather (freezing rain-ZR, freezing drizzle-ZL, ice pellets-IP, and thunderstorm-TRW) forecasted (fcst) and observed (obs) values.

Element	Criterion	Forecast	Amend	Alert
Ceiling (ft)	1	no cig, cig > 8000	obs $\leq$ 4000	4000 < obs $\leq$ 6000
	2	4000 < cig $\leq$ 8000	obs $\leq \frac{fcst}{2}$	obs $\leq$ fcst - $\frac{fcst}{4}$
	3	1000 $\leq$ cig $\leq$ 4000	a) obs $\geq$ fcst x 2	a) obs $\geq$ fcst + $\frac{fcst}{2}$
			b) obs $\leq \frac{fcst}{2}$	b) obs $\leq$ fcst - $\frac{fcst}{4}$
	4	cig < 1000	$\lvert fcst-obs \rvert \geq 300$	$\lvert fcst-obs \rvert \geq 200$
Visibility (mi)	1	vis > 6	obs $\leq$ 3	3 < obs $\leq$ 4
	2	1 < vis $\leq$ 6	a) obs $\leq \frac{fcst}{2}$	a) obs $\leq$ fcst - $\frac{fcst}{4}$
			b) obs $\geq$ fcst x 2	b) obs $\geq$ fcst + $\frac{fcst}{2}$
	3	vis $\leq$ 1	$\lvert fcst - obs \rvert \geq 1/2$	$\lvert fcst - obs \rvert \geq 1/4$
Wind Speed (kt)	1	spd < 10	obs $\geq$ 15	obs $\geq$ 12
	2	10 $\leq$ spd $\leq$ 20	$\lvert fcst - obs \rvert \geq 10$	$\lvert fcst - obs \rvert \geq 7$
	3	spd > 20	$\lvert fcst - obs \rvert \geq 20$	$\lvert fcst - obs \rvert \geq 15$
Wind Direction (deg)	1	dir = fcst	obs $\geq$ fcst $\pm$ 50 and spd $\geq$ 20	obs $\geq$ fcst $\pm$ 30 and spd $\geq$ 20
	2	dir = fcst and spd $\geq$ 20	obs $\geq$ fcst $\pm$ 50 and spd < 20	obs $\geq$ fcst $\pm$ 30 and spd < 20
Weather	1	TRW (ZR, ZL, IP)	No TRW (ZR, ZL, IP) in past 2 hours	No TRW (ZR, ZL, IP) in past 1 hour
	2	No TRW (ZR, ZL, IP)	TRW (ZR, ZL, IP)	not applicable

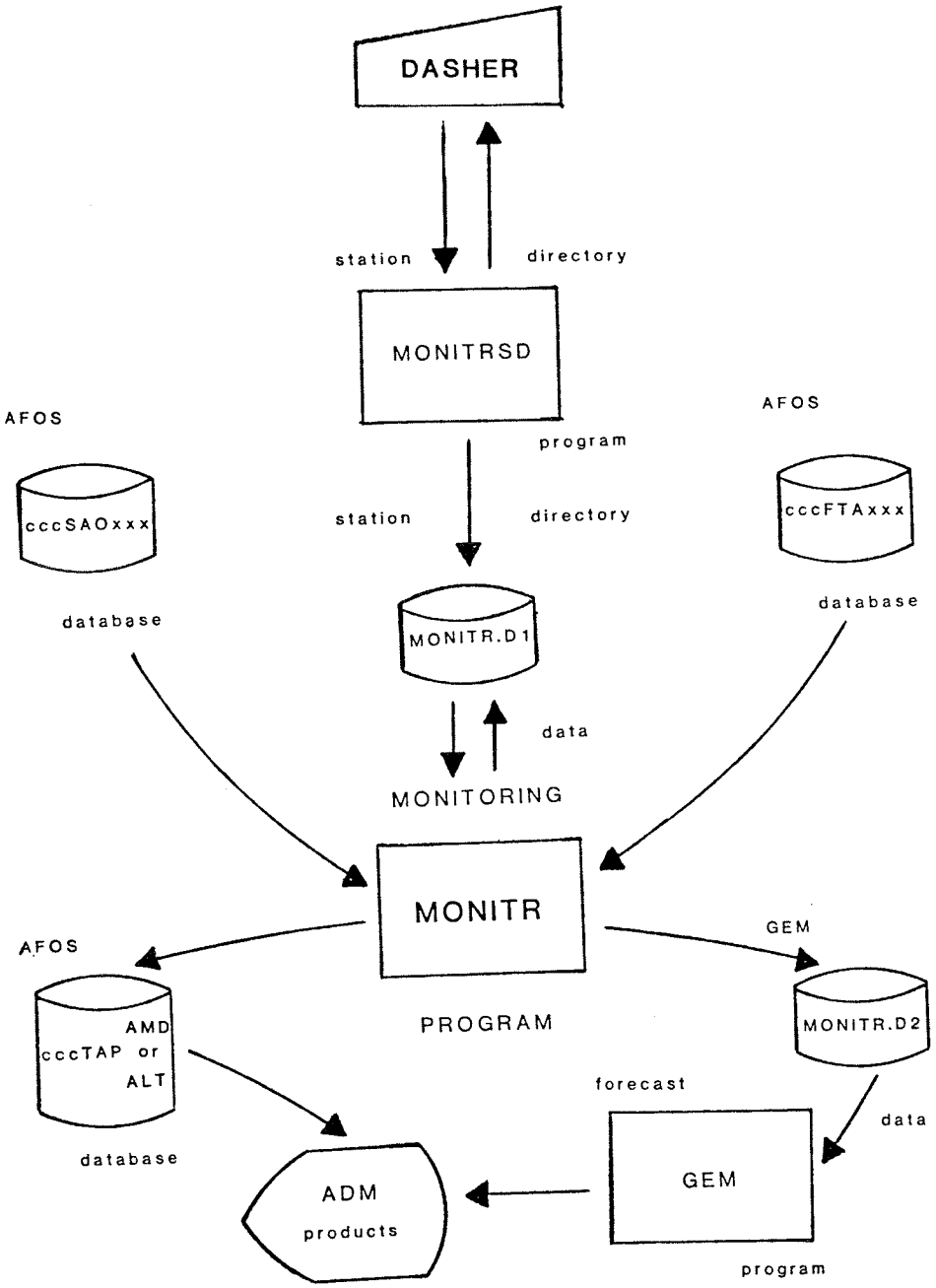


Figure 1. Data flow and program relationships for the monitoring (MONITR) and updating (GEM) system. See Herrmann (1983) for specific information on the GEM program. Program names are inside boxes. Disk and AFOS data sets are indicated by a disk platter symbol with the name of the set inside the symbol.

MONITRSD

MAIN PROGRAM

MONITRSD

SUBROUTINES

None

LOAD LINE

RDLR MONITRSD BG.LB UTIL.LB FORT.LB

MONITR

MAIN PROGRAM

MONITR

SUBROUTINES

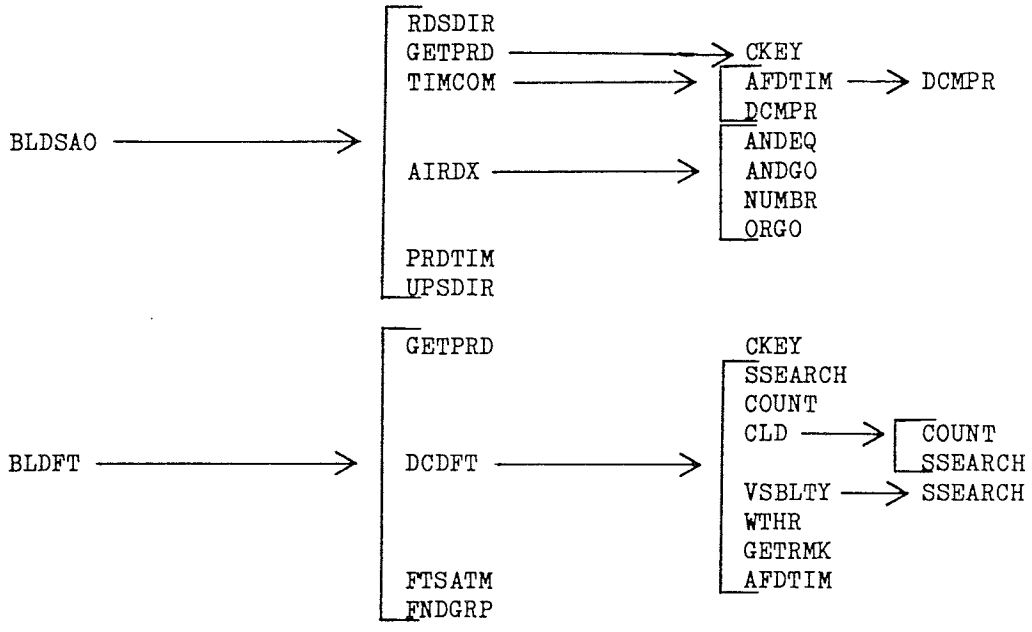
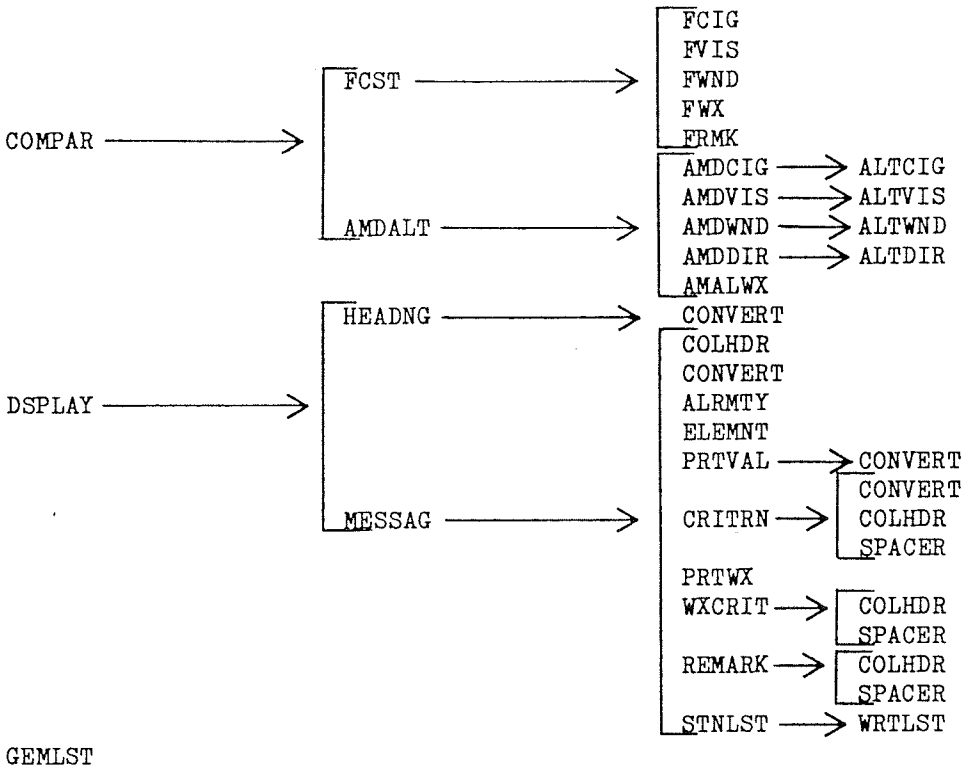


Figure 2. Software structure and load line for program MONITRSD and program MONITR. MONITRSD is used only once to create the station directory which is then used and updated by the FT monitoring program, MONITR (continued on next page).



LOAD LINE

```
RLDR MONITR GETPRD CKEY AFDTIM DCMPR
     TIMCOM CRITRN GEMLST MESSAG AIRDX
     PRDTIM STNLST [BLDFT DCDFT GETRMK
     CLD COUNT SSEARCH VSBLTY WTHR
     FTSATM FNDGRP, BLDSAO RDSDIR UPSDIR
     ANDEQ ANDGO NUMBR ORGO COMPAR FCST
     AMDALT FCIG FVIS FWND FWX FRMK
     AMDCIG ALTCIG AMDVIS ALTVIS AMDWND
     ALTWND AMDDIR ALTDIR AMALWX, DSPLAY
     HEADNG REMARK CONVERT COLHDR SPACER
     ALRMTY ELEMNT PRTVAL PRTWX
     WXCRIT WRTLST] BG.LB UTIL.LB FORT.LB
```

Figure 2. (continued).

WBCTAPAMD
TAP MESSAGE 112203

TERMINAL	FT(Z)	SAO(Z)	AMEND/ALERT	ELEMENT	FORECAST	OBSERVED	AMEND IF OBSERVED IS
BWI	1800	2148	AMEND	CEILING	200	NO CIG	NO CIG, .GE. 500, .LE. 100
			AMEND	VSBLITY	1.50	15.00	.LE. .75, .GE. 3.00
				FT REMARK: NONE FOUND			
DCA	1800	2200	ALERT	WND DIR	350	030	.LE. 300, .GE. 040
				FT REMARK: NONE FOUND			
IAD	2000	2200	AMEND	CEILING	500	1000	NO CIG, .GE. 800, .LE. 200
				FT REMARK: OCNL SCT			

NO FT AMENDMENTS OR ALERTS WERE INDICATED:

MTN	CHO	DAN	LYH
PHF	ORF	RIC	ROA
SBY	ILG		

Figure 3. An example of the output product produced by MONITR. This product would be stored as cccTAPAMD, where ccc in this example is WBC.

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