United States
Environmental Protection
Agency

Office of Air Quality
Planning and Standards
Research Triangle Park, NC 27711

EPA-454/B-96-002
Replaces: EPA-454/B-94-020
August, 1996

Air

EPA

METEOROLOGICAL PROCESSOR FOR REGULATORY MODELS (MPRM) USER'S GUIDE

TECHNICAL REPORT DATA

(Please read Instructions on reverse before completing)

1. REPORT NO. EPA-454/B-96-002	2.	3. RECIPIENT'S ACCESSION NO.
4. TITLE AND SUBTITLE Meteorological Processor for Regulatory Models (MPRM) User's Guide		5. REPORT DATE August 1996 6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S) Desmond T. Bailey		8. PERFORMING ORGANIZATION REPORT NO.
9. PERFORMING ORGANIZATION NAME AND ADDRESS U.S. Environmental Protection Agency Office of Air Quality Planning and Standards Research Triangle Park, NC 27711		10. PROGRAM ELEMENT NO. 11. CONTRACT/GRANT NO.
12. SPONSORING AGENCY NAME AND ADDRESS		13. TYPE OF REPORT AND PERIOD COVERED 14. SPONSORING AGENCY CODE
15. SUPPLEMENTARY NOTES		

16. ABSTRACT

The Meteorological Processor for Regulatory Models (MPRM) is a general purpose program used to process meteorological data for use in EPA recommended air quality dispersion models. Capabilities include quality assessment of meteorological data, detailed report generation, and the ability to process a variety of meteorological data bases including both on-site (user collected) and National Weather Service (NWS) meteorological data.

MPRM is comprised of three processing stages. Stage 1 (extraction and quality assessment) retrieves meteorological data from various storage media provided by the user (e.g., magnetic tape, floppy disk, and CD-ROM) and conducts the quality assessment of these data. The stage 1 report files provide listings of missing, suspect, and invalid data. These reports provide necessary information allowing users to correct problem data prior to its use in modeling. Stage 2 merges the corrected stage 1 data from the various MPRM pathways - upper air (UA), surface (SF) and on-site (OS). The third and final stage performs the necessary processing to create a meteorological data file for use in a dispersion model selected by the user. MPRM supports the following air quality dispersion modelos which are recommended by EPA for use in regulatory applications (Appendix W to 40 CFR, Part 51): BLP, CALINE-3, CDM 2.0, COMPLEX1, ISCST, ISCLT, RAM, RTDM, and VALLEY.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Air Pollution Atmospheric Dispersion Modeling Meteorological Processors Meteorological Monitoring		

18. DISTRIBUTION STATEMENT Release Unlimited	19. SECURITY CLASS *(Report)* Unclassified	21. NO. OF PAGES 200
	20. SECURITY CLASS *(Page)* Unclassified	22. PRICE

EPA-454/B-96-002
Replaces: EPA-454/B-94-020

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USER'S GUIDE

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PREFACE

This document revises and replaces the October 1994 MPRM User's Guide. The revisions reflect necessary changes associated with the August 1995 revision of Appendix W to 40 CFR Part 51; these changes are implemented in the revised MPRM (dated 96225). This guide as well as the source code, executable, and test case files for MPRM are available for downloading from the EPA Technology Transfer Network (TTN), Support Center for Regulatory Air Models (SCRAM) electronic bulletin board.

The modular design of MPRM facilitates the ready adaptation of the processor to changes in technology. Consequently, it is anticipated that MPRM will be updated as necessary to accommodate new input/output formats for meteorological data, new dispersion models, and new processing techniques.

This guide was prepared using WordPerfect 5.1 word processing software and, as such, is available in both hard copy and soft (electronic) copy. Hard copies of the user's guide are available from the National Technical Information Services (NTIS), Springfield, VA 22161 (phone (703) 487-4650); ask for NTIS document No. PB96-180518. Copies of the user's guide in WordPerfect 5.1 format may be obtained from the TTN SCRAM bulletin board; phone (919) 541-5742.

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The Meteorological Processor for Regulatory Models (MPRM) is a general purpose program used to process meteorological data for use in EPA recommended air quality dispersion models. Capabilities include quality assessment of meteorological data, detailed report generation, and the ability to process a variety of meteorological data bases including both on-site (user collected) and National Weather Service (NWS) meteorological data.

MPRM is comprised of three processing stages. Stage 1 (extraction and quality assessment) retrieves meteorological data from various storage media provided by the user (e.g., magnetic tape, floppy disk, and CD-ROM) and conducts the quality assessment of these data. The stage 1 report files provide listings of missing, suspect, and invalid data. These reports provide necessary information allowing users to correct problem data prior to its use in modeling. Stage 2 merges the corrected stage 1 data from the various MPRM pathways - upper air (UA), surface (SF) and on-site (OS). The third and final stage performs the necessary processing to create a meteorological data file for use in a dispersion model selected by the user.

MPRM supports the following air quality dispersion models which are recommended by EPA for use in regulatory applications (Appendix W to 40 CFR Part 51): BLP, CALINE-3, CDM 2.0, COMPLEX1, ISCST, ISCLT, RAM, RTDM, and VALLEY.

TABLE OF CONTENTS

Appendices

LIST OF FIGURES

LIST OF TABLES

EPA-454/B-96-002
Replaces: EPA-454/B-94-020

REVISION HISTORY

Version 1.1, MPRM (dated 89142), was released and made available on the SCRAM Bulletin Board in May 1989.

Version 1.2, MPRM (dated 90045), was released in February 1990. This release corrects a problem in the STAGE3 processing of calm conditions. Details are provided in MPRM Model Change Bulletin #2 (MCB#2) on the SCRAM Bulletin Board.

Version 1.3, MPRM (dated 93140), was released in May 1993. This release corrected 'bugs' in all three stages of MPRM processing and incorporated revisions to enhance user-friendliness. Details are provided in MPRM MCB#3 on the SCRAM Bulletin Board.

MPRM (dated 96225), was released in August 1996. This release implemented changes to MPRM associated with the August 1995 revision of Appendix W to 40 CFR Part 51. Details are provided in MCB#4 on the SCRAM Bulletin Board.

ACKNOWLEDGMENTS

Roger W. Brode, John S. Irwin, and James O. Paumier coauthored the first release of the user's guide in July 1988. Other contributors to the July 1988 release included: Carol Brown; Dr. P.M. Barlow; Phil Boone; and Russell F. Lee. The user's guide was revised, converted to Wordperfect, and re-released in October 1994; Desmond T. Bailey was the project officer for these activities. Dr. Bailey also served as editor for the August 1996 revisions to the user's guide. Peer review for the August 1996 document was provided by Roger W. Brode (PES), Tom Coulter (U.S. EPA, OAQPS), and Jerry Crescenti (U.S. EPA, NERL).

SECTION 1

INTRODUCTION

The Meteorological Processor for Regulatory Models (MPRM) is a general purpose program used to process meteorological data for use in EPA recommended air quality dispersion models. Capabilities include quality assessment of meteorological data, detailed report generation, and procedures for processing a variety of meteorological data bases including both on-site (user collected) data and National Weather Service (NWS) meteorological data.

1.1 Relationship to Modeling Guidance

MPRM supports most of the refined air quality dispersion models preferred by EPA for use in regulatory applications. These models are described in Appendix W to 40 CFR Part 51. A list of the models supported by MPRM is provided in Section 3.2.

MPRM includes enhancements which support requirements promulgated in the August 1995 revision of Appendix W to 40 CFR Part 51. These enhancements are: 1) coding to implement the Solar Radiation Delta-T (SRDT) method of stability classification and 2) algorithms to calculate boundary layer parameters which are used in the revised Industrial Source Complex (ISC) model to estimate deposition velocity and plume depletion. A related enhancement, not part of the August 1995 revisions, involves the processing of hourly precipitation data for use in wet deposition calculations.

The data processing methods incorporated in MPRM implement the recommendations of the "On-Site Meteorological Program Guidance for Regulatory Modeling Applications" (U.S. EPA, 1987). These recommendations include methods for estimating Pasquill-Gifford (P-G) stability categories from on-site measurements, and procedures for processing wind data to obtain the scalar averaged wind direction and the standard deviation of the wind direction. Guideline recommendations for processing wind, temperature, stability category and mixing height are implemented as default procedures in MPRM; these are identical to the default procedures employed in RAMMET and PCRAMMET.

The MPRM user's guide provides necessary information related to the QA and processing of meteorological data for use in dispersion modeling - it is not intended to provide guidance on the regulatory aspects of dispersion modeling - for such guidance, user's are referred to Appendix W to 40 CFR Part 51. Users should refer to the appropriate model user's guide for information related to specific models, to the on-site guidance (U.S. EPA, 1987) for information on meteorological monitoring, and to the "Quality Assurance Handbook for Air Pollution Measurement Systems, Volume IV Meteorological Measurements" (U.S. EPA, 1995) for guidance on the quality assurance of meteorological measurements.

1.2 Sources of Meteorological Data

National Weather Service (NWS) meteorological data are available from the National Climatic Data Center (NCDC) in Ashville, NC (http://www.ncdc.noaa.gov). These data are available on a variety of storage media (magnetic tape, floppy diskette, and CD ROM). MPRM will process data from a selected subset of NCDC formats as follows: TD-5600 (upper air data); TD-9689 (estimated mixing heights); TD-3240 (hourly precipitation); CD-144 (surface data).

Selected NCDC data are also available on the EPA Technology Transfer Network (TTN) SCRAM Bulletin Board. These include NCDC estimated mixing height data and NWS surface data. The SCRAM formats for both of these data types differ from the NCDC formats; e.g., the SCRAM surface data are stored in a compressed format which includes only those variables that are necessary for dispersion modeling. The NCDC and SCRAM formats applicable to MPRM are described in Appendix F.

Use of site specific (on-site) meteorological data has always been encouraged for applications of dispersion modeling and is required for some regulatory applications; e.g., complex terrain (Appendix W to 40 CFR Part 51). On-site meteorological monitoring programs conducted in support of such requirements result in data files with varying formats. The formats for these files can be included in the input runstream to MPRM. This provides flexibility within MPRM for processing these generic format data files. This capability is discussed in Section 3.

1.3 Importance of Quality Assessment

MPRM was designed with built in procedures to quality assess meteorological data prior to its use in modeling. The QA process flags suspect and/or invalid data and facilitates the correction of such data. In many instances this may be the only QA performed on the meteorological data used in modeling. Given the types of decisions that may be based on modeling estimates, one should not wait until after the fact (i.e., after the modeling is completed) to QA the meteorological data - it is better to be informed as to the quality of the data before hand. In some instances, a particular data set may be rejected for failure to meet QA criteria.

1.4 Missing Data

Short-term dispersion models require hourly meteorological data and in many cases will not accept missing data; i.e., there must be a valid record for every hour in the analysis period. Users should always check to see that the meteorological data set they intend to use is complete (does not contain missing data). If the data are not complete, and the model they intend to use does not allow missing data then procedures to complete the data base will need to be implemented. Such procedures are often case specific and may require prior approval by the permit granting authority. For regulatory applications, substitutions, to fill in missing data, may not exceed 10 percent. Users are referred to the section on 'Completeness Requirements' in (U.S. EPA, 1987) for more detailed guidance on handling missing data (see also Sections 6.3.2 and 6.3.6).

Note, in preparing to process data with MPRM, one needs to review the values used (in the raw input data file) to identify missing (null) data to ensure correspondence with the MPRM missing value indicators listed in Appendix C. If the values do not agree, the default missing value indicator(s) should be changed to correspond with the values used in the data file (see Section 2.1). Failing this, MPRM may interpret missing data as being out of range.

1.5 Support for ISC Deposition Estimates

MPRM includes the following enhancements in support of ISC deposition estimates:

Algorithms for Boundary Layer Parameters - Estimates of two boundary layer parameters (the friction velocity and Monin-Obukhov length) are required in the revised ISC short-term model (ISCST) for use in deposition and plume depletion calculations. MPRM includes the necessary algorithms for estimating these parameters. The friction velocity (u_*) is a measure of the stress due to wind shear at the earth's surface. The Monin-Obukhov length (L) is a stability parameter that relates the friction velocity to the transfer of heat. The computations require user specified surface characteristics including albedo, Bowen ratio, and roughness length. The surface characteristics are allowed to vary with time of year and/or wind direction (sector).

Processing of Hourly Precipitation Data - Hourly precipitation data are required in ISCST for use in estimating wet deposition. To support wet deposition estimates, MPRM has been enhanced to accommodate processing precipitation data available on SAMSON CD_ROM and TD-3240 precipitation data files both of which are available from the National Climatic Data Center (NCDC).

1.6 MPRM Syntax

We refer to the input necessary to run the MPRM processor as the input run stream or simply run stream. The run stream consists of several 80-character images, each of which begins with a 2-character group, called a pathway; this is followed by a 3-character group, called a keyword.

Each input run stream can be thought of as a sequence of 80-character images. Each image consists of two or more fields. The fields presented within the 80-character image are considered FREE format; that is, proper interpretation of a field is not dependent on column position. However, the fields must be separated by commas or spaces.

Pathways - The logic, and hence the input to the processor, is divided into six functional areas called pathways. These are identified by two-letter acronyms as follows:

- JB - processes that affect or pertain to the entire job
- UA - processes related to NWS upper air data and NCDC mixing height estimates
- SF - processes related to NWS hourly surface data
- OS - processes related to site specific (on-site) meteorological data
- MR - processes related to the merging of meteorological data
- MP - processes related to creating meteorological data files for use in dispersion modeling

The structure of the input is such that, with some experience, one should be able to interpret an input run stream with minimal effort. The keywords associated with each of the pathways are summarized in Appendix A; note that some keywords may be used with several pathways and that some keywords are mandatory while others are optional. The keywords and associated input syntax are described in Appendix B. Together these two appendices should enable the user to construct customized run streams.

1.7 Stages of Processing

MPRM is packaged in two separate executable programs (STAGE1N2.EXE and STAGE3.EXE) comprising three processing stages (see Figure 1-1). The three stages implement the following processes:

1. Extract and quality assurance
2. Merge
3. Process and create files for use in dispersion modeling

1.8 Getting Started

Example input runstreams, meteorological data files, and MPRM output and report files have been packaged with the test cases for MPRM and are available, along with the executables for MPRM, for downloading from the EPA Technology Transfer Network (TTN) Support Center for Regulatory Air Modeling (SCRAM) electronic bulletin board. If you have not already done so, these files should downloaded and copied to a working directory. The instructions in Sections 2 and 3 refer to the example test cases which should be especially helpful to new users in negotiating the learning curve for MPRM. Experienced users may wish simply to exercise the test cases and refer to Sections 2 and 3 for reference.

It should be noted that the input run streams are sufficiently long and complex to preclude direct input from the keyboard. Instead, a text editor should be used to create the necessary input files. These files should consist of standard ASCII characters only. Note, some text editors differentiate between document files, which contain special non-ASCII control characters, and non-document files, which are composed of ASCII characters only. For such editors, be sure to select the non-document mode of editing.

1.9 Document Overview

Section 2 provides instructions and examples for Stage 1 (Extraction and Quality Assessment) and Stage 2 (Merge). Section 3 provides instructions and examples for Stage 3 (Creating files for use in modeling). Section 4 provides information on the scientific basis for the processing algorithms in Stage 3. Section 5 provides instructions for compiling the source code and other information of interest to programmers. Section 6 provides information on the interpretation of error messages.

There are seven appendices as follows: Appendix A presents a summary of the keywords used in defining the input to the processor and denotes those that are mandatory and those that are optional. Appendix B describes usage, limitations, and syntax of each keyword. Appendix C provides information on the meteorological variables processed on each of the pathways giving the variable name, a brief description, units, missing value indicator, and default upper and lower bounds. Appendix D describes the test cases for MPRM (dated 96030) and provides selected examples. Appendix E describes various types of messages that are generated by the processor. Appendix F describes the computer file formats used for the storage of the extracted data. Appendix G is a glossary of commonly used terms associated with processing of meteorological data.

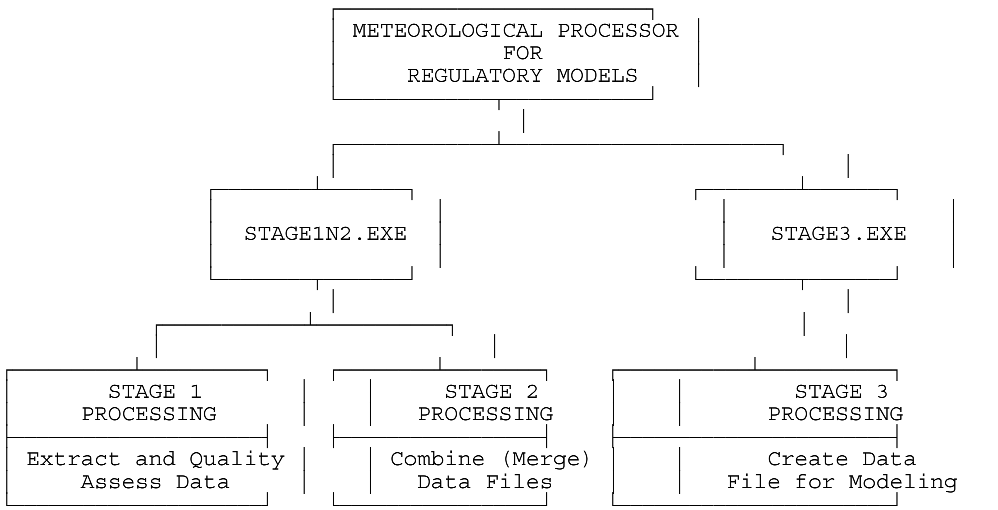

Figure 1-1. Overview of processing stages within MPRM.

SECTION 6

TROUBLE SHOOTING

6.1 Abnormal Job Termination

The developers of MPRM anticipated that users of the software would occasionally make mistakes and, consequently, have built in capability for error detection and reporting. These error tracking procedures include such things as checks for correct use of MPRM syntax, presence/omission of mandatory keywords, parameters, etc., and the availability of specified files. The more serious/fatal errors result in an 'Abnormal Job Termination'.

If a fatal error is detected, a message indicating an abnormal job termination will be written to the file defined in the JB OUT input image, if provided, or to the screen if a report file has not been specified. In the latter case, one would not necessarily be aware of the abnormal job termination. As this could lead to problems in subsequent processing, one should always check the report file for the job status at the completion of each processing stage. A successful run is indicate by a 'Job Terminated Normally' message.

An example report file from a job with a fatal error in the input run stream is shown in Figure 6-1. The example is based on the Stage 1 example (extraction and QA of upper air data) discussed in Section 2.1.1. Recall that the IQA input image is used in Stage 1 to specify the file name for the output of the extraction process and is mandatory for Stage 1 processing of surface and upper air data. A fatal error results if, as in the example, this input image is missing; a message indicating the error is written to the Stage 1 error/message file and to the report file. The interpretation of these messages is discussed in Section 6.2.

6.2 Interpreting Run-time Error and Warning Messages

The messages generated by this example are shown in Figure 6-2. The fourth record is the message resulting from the omission of the UA IQA image. The message is deciphered as follows:

```
0 JB W12 UAEXST: SUMMARY: MISSING/ERRORS IN UA-IQA CARD
│ │  │   │      └──────────────┬───────────────────┘
│ │  │   │                     └─ Message (up to 40 characters)
│ │  │   │
│ │  │   └─ Subroutine where message was generated
│ │  │
│ │  └─ Message code (Appendix E)
│ │
│ └─ Pathway identification
│
└─ Counter
```

The structure of all messages is identical. In the first field of the message is a counter, which in this particular case has no significance. The second field indicates that the message was generated at the JB level of logic within the processor. The conditions for the generation of messages are:

- JB messages - most often when problems are encountered in deciphering the input run stream or when the processor detects incomplete run stream information.

- UA, SF, OS, and MR messages - when problems are encountered in deciphering an input run stream for the respective pathway, when data cannot be properly read, or when suspect data are encountered during a quality assessment check.

The third field is a three-character message code. The first character indicates the type of message: informational (I), warning (W), error (E), quality assessment (Q), trace (T). In the example, the W indicates that this message is a warning. Warnings do not necessarily prohibit data processing, error messages do. The two numbers following the first character are used to provide additional information concerning this message. This additional information is provided in Appendix E. In general, messages concerning input run stream have message numbers from 0 to 20. Message numbers greater than 20 are generated while reading data files or during quality assessment checks. The information provided in Appendix E for message W12 is: "Missing/errors on an input image - may or may not be fatal depending on the processing requested."

All messages generated during processing can be found in the error/message file, defined in the JB ERR input image. This file can be very long if there are a substantial number of messages; therefore, the file should be reviewed prior to printing to determine if printing of the entire file is appropriate.

6.3 Other Run-time Problems

6.3.1 SF W43 SFLEVS:OVRPNCH 11

The following warning message may appear during Stage 1 processing of NWS surface data:

0SF W43 SFLEVS:OVRPNCH 11, IMPROPER DECODE ON 33622/ 1

The warning is caused by the presence of a "K" in column 58, used to denote "cloud type". It turns out that characters such as "K", "M", "N", "O", and "R" normally occur in this field as necessary to indicate certain cloud types. The warning may be disregarded.

6.3.2 Missing Records

MPRM expects the data files provided for processing to be complete; i.e., there should be a record for each hour in the period defined in the EXT (extraction) input image. Missing records can be detected indirectly in the report files for Stages 1 and 2. If one or more records are missing, the number of records extracted, as indicated in the Stage 1 report, will be less than expected based on the extraction period. In such cases, the Stage 2 report should be checked to determine when the missing records occurred; missing records are indicated by a mismatch in the number of hours merged for a 24-hour period. Files with missing records will not normally cause a fatal error in Stage 1 or 2. However, such files should not be passed on to Stage 3 processing as unexpected results may be obtained. See also discussion of missing data in Section 1.4 and discussion of floating point errors in Section 6.3.6.

6.3.3 UA Processing not always needed

Users should note that upper air data are not required for some of the models supported by MPRM. The models that do not require upper air data are: VALLEY, ISCLT, and CDM 2.0. Stage 1 and Stage 2 processing in support of these models need not include data for the upper air (UA) pathway.

6.3.4 Hourly Label for On-site Data

Users should note that MPRM assumes that the label assigned to an hourly observation or hourly average is the integer value for the hour beginning; e.g., an hourly average for the period 01:00 to 02:00 should be assigned a time label of 01.

6.3.5 Hourly Labels - On-site versus NWS Data

Users should note that MPRM expects on-site data to be reported using a 01-24 hour clock, the same clock that MPRM uses internally for processing. In preparing to merge NWS data, which are reported using a 00-23 hour clock, MPRM reassigns the first record in each day (i.e., the record with the hourly label: '00') to the previous day (relabeled as hour '24'). This in effect results in a mismatch at the end of a merge file of OS and SF data as the last record would not normally include data for the SF pathway. To avoid this mismatch, users should always extract an extra record from SF files. If necessary, the extra record should be appended to the end of the SF file.

6.3.6 Floating Point Error in Stage 3

If a floating point error occurs during Stage 3 processing and no obvious cause presents itself, users should check to ensure that the meteorological data file is complete; i.e., there should be no missing records (see discussion of missing records in Section 6.3.2). One instance in which such errors have occurred is in the processing of NWS surface data to determine P-G stabilities using the WNDWXX procedure (Table 4-1). A suggested solution, if missing records are causing problems, is to insert necessary dummy records in the NWS surface data file and reprocess the data beginning with Stage 1. The dummy records should contain the station and date/time identifiers in columns 1-13; other fields should be filled as per the guidance provided on SCRAM (see also discussion of missing data in Section 1.4).

```
        METEOROLOGICAL PROCESSOR FOR REGULATORY MODELS [MPRM (dated 96030)]

                          26-APR-96     15:32:43

               STAGE 1 EXTRACTION AND QA OF METEOROLOGICAL DATA


            ********************************************************
            ***             ABNORMAL JOB TERMINATION             ***
            ********************************************************

                 STATUS REPORT PRIOR TO BEGINNING PROCESSOR RUN


 1.  REPORT FILE NAMES

      ERROR MESSAGES: TEST121.ERR
      SUMMARY OF RUN: TEST121.RPT


 2.  UPPER AIR DATA

      SITE ID    LATITUDE(DEG.)   LONGITUDE(DEG.)
        24157       47.63N          117.53W

     THE PROCESS(ES) MPRM ANTICIPATES TO PERFORM ARE:

           NONE- ERROR(S) ON INPUT IMAGES FOR THIS PATH

          EXTRACT INPUT -    OPEN: 24157-94.MIX
          QA OUTPUT     -    OPEN: OQAUA.121

          THE EXTRACT DATES ARE:    STARTING: 31-OCT-94
                                      ENDING:  1-DEC-94


 3.  NWS SURFACE DATA

     THE PROCESS(ES) MPRM ANTICIPATES TO PERFORM ARE:

           NONE - NO DATA TO BE PROCESSED ON THIS PATH

 4.  ON-SITE DATA

     THE PROCESS(ES) MPRM ANTICIPATES TO PERFORM ARE:

           NONE - NO DATA TO BE PROCESSED ON THIS PATH


                     **** MPRM MESSAGE SUMMARY TABLE ****

         0- 9   10-19   20-29   30-39   40-49   50-59   60-69   70-79   TOTAL
       ----------------------------------------------------------------------

    JB
      E    0       0       0       0       0       0       0       0       0
      W    0       1       0       0       0       0       0       0       1
      I    2       7       0       0       0       0       0       0       9
       ----------------------------------------------------------------------
           2       8       0       0       0       0       0       0      10

        ****   WARNING MESSAGES ****
         0 JB W12 UAEXST: SUMMARY: MISSING/ERRORS IN UA-IQA CARD

        ****    ERROR MESSAGES  ****

               ---  NONE  ---
```

Figure 6-1 Example report file for extraction and QA of mixing heights

```
  5 JB I00 DEFINE: BLANK CARD FOUND, SKIP TO NEXT IMAGE
  8 JB I00 DEFINE: BLANK CARD FOUND, SKIP TO NEXT IMAGE
 13 JB I19  SETUP: FOUND "END OF FILE" ON DEVICE DEVIN  5

  0 JB W12 UAEXST: SUMMARY: MISSING/ERRORS IN UA-IQA CARD

  0 JB I10   TEST: SUMMARY: NO SF-EXT CARD, NULL EXTRACT
  0 JB I11   TEST: SUMMARY: NO SF-IQA CARD, NULL QA
  0 JB I12   TEST: SUMMARY: NO SF-OQA CARD, NULL MERGE
  0 JB I10   TEST: SUMMARY: NO OS-EXT CARD, NULL EXTRACT
  0 JB I11   TEST: SUMMARY: NO OS-IQA CARD, NULL QA
  0 JB I12   TEST: SUMMARY: NO OS-OQA CARD, NULL MERGE
```

Figure 6-2 Example error/message file for extraction and QA of mixing heights.

SECTION 5

NOTES FOR PROGRAMMERS

5.1 Introduction

The original MPRM processor was designed and coded to run on most operating systems of the day. In 1988 when MPRM was first released these included VAX and IBM mainframes, and the IBM PC-XT and compatible personal computers. Since then personal computing power has advanced considerably, whereas mainframe computing has remained relatively static. The changes to MPRM over the years reflect these trends; i.e., no new features have been added and few changes have been made to routines that are mainframe oriented. As this trend continues, it is expected that there will be a diminishing need to maintain a mainframe compatible code.

The advances in personal computing which most affect MPRM are the increase in processing speed, the increase in memory, and the introduction of CD-ROM memory. The IBM PC-XT, which was state-of-the-art in 1988, was limited to 640K of main memory. The original MPRM processor was designed with this memory limitation in mind; a modular design was necessary in order to make use of overlays during execution.

Advances in PC memory structure over the years have essentially done away with the 640K limitation such that overlays are fast becoming a thing of the past. Some of the recent additions to MPRM (e.g., the incorporation of the random number file in the source code) have more-or-less assumed that the processor would be run on a PC with extended memory.

The following topics are covered in the remainder of Section 5: Fortran Compatibility and Extensions (Section 5.2), Compiling for Extended Memory (Section 5.3).

5.2 Fortran Compatibility and Extensions

To retain portability, the MPRM processor was coded using American National Standards Institute (ANSI) Fortran X3.9-1978 or, as it is more commonly known, Fortran-77. Extensions to Fortran-77 were avoided with the following exceptions: INCLUDE statements, OPEN statements, character conversion, system date and time, and extended error handling. These are described in the following. The filenames of the MPRM Fortran source code files are listed in Table 5-1.

5.2.1 INCLUDE Statements

Nearly all the subroutines in the MPRM processor contain statements to include named COMMON blocks. The method for incorporating these statements into the source code varies according to the compiler in use, but all use some form of the nonstandard INCLUDE statement. These statements appear as extensions to VAX-11 FORTRAN (version 3.0), IBM VS FORTRAN (version 2), RM/FORTRAN (version 2.10), Microsoft FORTRAN (version 4.1), and Lahey FORTRAN (version 5.2). The syntax for each of these is shown below. The punctuation is required where shown except for the left and right bracket, which indicates an optional parameter. In the accompanying examples, the assumption is made that the INCLUDE files are in the same subdirectory or partitioned data set as the main programs and subroutines that use them.

VAX-11 FORTRAN

INCLUDE 'filename[/LIST]', where filename is any valid VAX file specification and /LIST, which is optional, indicates that the statements are to be listed in the compilation source listing. If /LIST is omitted then no listing of the included files appears in the compilation listing.

Example: INCLUDE 'MAIN1.INC/LIST'

IBM VS FORTRAN

INCLUDE (name) [n], where name is the member name in the partitioned data set and n is a value used to decide whether or not to include the file during compilation. This parameter can be omitted, in which case the file is included, or can take on a value from 1 to 255. If the value of n appears in the CI compile option, then the file is included, otherwise it is omitted. This is not the simple list or no list option, rather it includes or excludes the named member in the compilation.

Example: INCLUDE (MAIN1)

RM/Fortran, version 2.10
Microsoft Fortran, Version 5.1
Lahey Fortran, Version 5.2

INCLUDE 'filename', where filename is any valid DOS file specification.

Example: INCLUDE 'MAIN1.INC'

5.2.2 OPEN Statements

The subroutines that use OPEN statements for disk files and magnetic tapes have been placed in separate files to expedite the transfer of source code between systems. These files are SETUPVX.FOR for VAX applications, SETUPPC.FOR for PC applications and SETUPIBM.FOR for IBM mainframe applications. The subroutines in these files control the opening of disk files (subroutine FLOPEN) and magnetic tapes (subroutine TPOPEN) and perform operations on ASCII and EBCDIC positional codes.

5.2.3 Character Conversion

Subroutines for character conversion are contained in LIBVX.FOR (for VAX), LIBPC.FOR (for PC) and LIBIBM.FOR (for IBM). The character conversion subroutine (CHCONV) is used in converting EBCDIC characters on magnetic tape to ASCII characters. It uses the VAX octal representation of characters. This conversion is only required on the VAX. Because magnetic tape drives are not normally available on personal computers and because the IBM operates with EBCDIC, a dummy subroutine has been provided for these systems.

5.2.4 System Date and Time

Subroutines to return the system data and time are contained in the same files as the subroutines for character conversion: LIBVX.FOR (for VAX), LIBPC.FOR (for PC) and LIBIBM.FOR (for IBM).

5.2.5 Extended Error Handling

An extended error handling subroutine for use on IBM mainframes is included in LIBIBM.for. This routine allows uninterrupted processing of data files typically available from NCDC. Dummy subroutines are provided for VAX and PC applications.

5.3 Compiling for Extended Memory

Due to the large memory requirements, a compiler which makes use of extended memory is recommended. The MPRM source code has been compiled and tested using two extended memory compilers: the Lahey F77L-EM/32 Fortran compiler and the Lahey Fortran 90 compiler. Instructions for compiling and linking with these compilers are provided in Sections 5.3.1 and 5.3.2.

5.3.1 Lahey F77L-EM/32 Compiler

The commands to compile and link MPRM using the Lahey F77L-EM/32 Fortran extended memory compiler (version 5.2) are presented in the following:

```
f77l3 COMPLETE.FOR     /b /i /l /no /nw
f77l3 HEADER.FOR       /b /i /l /no /nw
f77l3 LIBFILE.FOR      /b /i /l /no /nw
f77l3 LIBPC.FOR        /b /i /l /no /nw
f77l3 MERGE.FOR        /b /i /l /no /nw
f77l3 MP2XFOR.FOR      /b /i /l /no /nw
f77l3 MP3XFOR.FOR      /b /i /l /no /nw
f77l3 MP4XFOR.FOR      /b /i /l /no /nw
f77l3 DEPMET1.FOR      /b /i /l /no /nw
f77l3 DEPMET2.FOR      /b /i /l /no /nw
f77l3 OSFILE.FOR       /b /i /l /no /nw
f77l3 OSSETUP.FOR      /b /i /l /no /nw
f77l3 OSSRPG.FOR       /b /i /l /no /nw
f77l3 SETUP.FOR        /b /i /l /no /nw
f77l3 SETUPPC.FOR      /b /i /l /no /nw
f77l3 SFFILE.FOR       /b /i /l /no /nw
f77l3 STAGE1N2.FOR     /b /i /l /no /nw
f77l3 STAGE3.FOR       /b /i /l /no /nw
f77l3 UAFILE.FOR       /b /i /l /no /nw
```

where the switches after the filename provide the following control:

/b	checks array subscripts and character substring bounds;
/i	interface checking between subprograms;
/l	lists line numbers in the event the executable program terminates abnormally;
/no	compiler options are not displayed when a file is compiled;
/nw	warning messages are not displayed when a file is compiled.

MPRM generates many warning messages as a result of the variables in the INCLUDE (.INC) files, hence, the /nw switch. If changes to the code are more extensive than the simple changes to array limits, then this switch should be removed to list the warning messages and identify potential problems.

After the Fortran source files have been compiled, they can be linked to create an executable program. To create the executable STAGE1N2.EXE, the following statement is used:

```
386LINK          STAGE1N2,COMPLETE,HEADER,SETUP1,SETUP2,
                 SETUPPC,SETUP,LIBFILE,LIBPC,
                 SFFILE,UAFILE,OSFILE,MERGE
                 -stub runb  -exe STAGE1N2.EXE  -pack
```

The switches after the filenames have the following effect:

-stub runb binds the Lahey/Phar Lap 386|DOS-Extender to the (protected-mode) executable,

-exe STAGE1N2 defines the name of the executable program, in this case, STAGE1N2.EXE, and

-pack performs data compression on the executable file.

The final step is optional and simply disables the 386|DOS-Extender banner that is shown whenever the executable program is run:

CFIG386 STAGE1N2.EXE -nosignon.

To create the executable STAGE3.EXE, the following statement is used:

```
386LINK    STAGE3,COMPLETE,HEADER,SETUP1,SETUP2,SETUPPC,
           OSSETUP,LIBFILE,LIBPC,
           MP2XFOR,MP3XFOR,MP4XFOR,OSSRPG,DEPMET1,DEPMET2
           -stub runb  -exe STAGE3.EXE  -pack
```

The switches after the filenames have the same effect as for STAGE1N2.EXE. As before, the final step is to disable the 386|DOS-Extender banner with

CFIG386 STAGE3.EXE -nosignon.

Note that a math coprocessor is required to use the Lahey-compiled executables. The minimum memory requirements to load STAGE1N2 is 807 Kb and 746 Kb to load STAGE3.

5.3.2 Lahey Fortran 90 Compiler

The commands to compile and link MPRM using the Lahey Fortran 90 compiler are presented in the following:

```
LF90  COMPLETE.FOR     -c -chk
LF90  DEPMET1.FOR      -c -chk
LF90  DEPMET2.FOR      -c -chk
LF90  HEADER.FOR       -c -chk
LF90  LIBFILE.FOR      -c -chk
LF90  LIBPC.FOR        -c -chk
LF90  MERGE.FOR        -c -chk
LF90  MP2XFOR.FOR      -c -chk
LF90  MP3XFOR.FOR      -c -chk
LF90  MP4XFOR.FOR      -c -chk
LF90  DEPMET1.FOR      -c -chk
LF90  DEPMET2.FOR      -c -chk
LF90  OSFILE.FOR       -c -chk
LF90  OSSETUP.FOR      -c -chk
LF90  OSSRPG.FOR       -c -chk
LF90  SETUP.FOR        -c -chk
LF90  SETUPPC.FOR      -c -chk
LF90  SFFILE.FOR       -c -chk
LF90  STAGE1N2.FOR     -c -chk
LF90  STAGE3.FOR       -c -chk
LF90  UAFILE.FOR       -c -chk
```

The link and link response files for Stage 1 are:

```
LF90 @LINK1N2.LRF -out STAGE1N2.EXE -pack -bind
CFIG386  STAGE1N2 -nosignon

STAGE1N2.OBJ COMPLETE.OBJ HEADER.OBJ SETUP1.OBJ
SETUP2.OBJ SETUPPC.OBJ OSSETUP.OBJ LIBFILE.OBJ LIBPC.OBJ
SFFILE.OBJ UAFILE.OBJ OSFILE.OBJ MERGE.OBJ
```

The link and link response files for Stage 3 are:

```
LF90 @LINK3.LRF -out STAGE3.EXE -pack -bind
CFIG386  STAGE3 -nosignon

STAGE3.OBJ COMPLETE.OBJ HEADER.OBJ SETUP1.OBJ
SETUP2.OBJ SETUPPC.OBJ OSSETUP.OBJ LIBFILE.OBJ
LIBPC.OBJ MP2XFOR.OBJ MP3XFOR.OBJ DEPMET1.OBJ
DEPMET2.OBJ MP4XFOR.OBJ OSSRPG.OBJ
```

Table 5-1

MPRM Source Code Files

Filename		Size	Date
BLOCK1	INC	12781	08-12-96
BLOCK2	INC	42312	08-10-95
MAIN1	INC	2582	04-02-95
MAIN2	INC	2292	02-02-95
MP1	INC	14200	08-09-96
OS1	INC	2871	10-20-95
OS2	INC	4904	08-09-96
SF1	INC	1765	08-06-95
SF2	INC	4323	02-15-95
UA1	INC	1395	08-31-94
UA2	INC	6826	08-09-92
WORK1	INC	2035	02-14-95
COMPLETE	FOR	37371	11-13-95
DEPMET1	FOR	26077	08-09-96
DEPMET2	FOR	15059	08-09-96
HEADER	FOR	15313	08-16-92
LIBFILE	FOR	76550	01-25-96
LIBPC	FOR	3541	08-14-96
MERGE	FOR	34641	01-25-96
MP2XFOR	FOR	44318	07-24-96
MP3XFOR	FOR	18961	05-14-96
MP4XFOR	FOR	77730	05-14-96
OSFILE	FOR	31637	07-22-96
OSSETUP	FOR	61921	08-09-96
OSSRPG	FOR	6905	01-23-96
SETUP1	FOR	56494	10-17-95
SETUP2	FOR	39813	11-30-95
SETUPPC	FOR	10163	02-09-95
SFFILE	FOR	107762	08-09-96
STAGE1N2	FOR	40469	01-25-96
STAGE3	FOR	43239	08-09-96
UAFILE	FOR	83947	12-04-95
LIBIBM	FOR	3258	09-14-88
LIBVX	FOR	7157	09-14-88
SETUPIBM	FOR	11508	09-20-92
SETUPVX	FOR	11019	04-16-92

SECTION 4

SCIENTIFIC NOTES

This section provides a brief technical description of the methods employed by MPRM during processing. All of the methods are documented in the indicated references to which the reader is referred for details. The methods employed during Stage 1 (Extraction and Quality Assessment) are described first, followed by descriptions of the methods employed in Stage 3 processing.

4.1 Stage 1

4.1.1 Averaging Sub-hourly Values

Hourly averaging is standard for most regulatory dispersion modeling and for the meteorological monitoring conducted in support of such modeling. Nevertheless, many on-site meteorological monitoring programs are designed for multiple purposes and consequently, employ sub-hourly averaging ranging anywhere from seconds to 30 minutes. The MPRM Stage 1 processor will accept sub-hourly averaged data ranging from 5 to 30 minutes. The number of observations per hour is specified using the optional run stream input image OS AVG. The default value is one observation per hour; the maximum value is 12 (5-minute averaging).

The sub-hourly values are averaged producing hourly values during the extraction process. For most variables the hourly value is computed as the arithmetic mean. Wind speed and direction, however, are treated differently in order to properly differentiate between cases when values are missing and cases when values are present but below instrument threshold. The threshold wind speed by default is 1.0 ms^{-1}; this can be redefined using the OS CLM input image. Wind speeds less than the threshold are given a value of one-half the threshold wind speed and the wind direction is treated as missing (this procedure for computing an hourly average should not be confused with the procedure for treatment of calms discussed in Section 4.2.1.2). The hourly wind speed is computed as an arithmetic mean. The hourly wind direction is computed according to the method given in (U.S. EPA, 1987) to properly account for the 0-360 degree crossover.

Hourly values of the standard deviation of the wind direction are computed as the root-mean-square of the sub-hourly values, in accordance with the recommendations in (U.S. EPA, 1987).

4.1.2 Quality Assessment

In Stage 1 processing, QA is performed on each pathway by comparing data values to the upper and lower bounds defined for each variable. Default QA bounds are defined in Appendix C, but these values can be overridden by the user with the CHK input image. The endpoints of the interval, i.e., the boundary values, are either included as acceptable data or excluded as questionable data according to the Range Check Switch field. This parameter can also be changed with the CHK input image. The default value of the Range Check Switch for each variable is also defined in Appendix C.

4.1.2.1 QA of Upper Air Data

Prior to performing the quality assessment on upper air soundings, the processor recomputes the heights reported in the soundings using the hypsometric formula. If the surface height is missing, the heights are not recomputed.

Because the upper air soundings contain multiple levels of data, vertical gradients of several variables can also be checked. This poses a question of how to report the audit results as there are a variable number of levels in a sounding and the heights of the levels differ from sounding to sounding. The MPRM solution is to stratify the data into ten height categories as follows: surface, 0 to 500 m, 500 to 1000 m, ... 3500 to 4000 m, and greater than 4000 m.

Lapse Rate - The gradient of temperature, or lapse rate, between two levels in the upper air data is checked against an upper and lower bound. The default maximum value is 5 °C/100 m and the default minimum is -2 °C/100 m. Note that these values are in units of °C/100 m; changes to the default values, using the UA CHK UALR input image, must be entered in the same units.

Wind Shear - Wind velocity has two components: speed and direction. The vertical gradient of the wind, or shear, can be expressed either as a vector shear in which both speed and direction are combined to yield one shear value, or speed and direction separately. The wind speed and direction shear are expressed separately in MPRM. The default maximum wind speed shear is 5 (ms-1)/100 m. Because the absolute difference of the speed is considered, i.e. the computation is independent of which level has the higher wind speed, the default minimum speed shear is 0 (ms^{-1})/100 m. The variable name for use with CHK to alter the range check parameters for the wind speed shear is UASS. The default maximum wind direction shear is 90 degrees/100 m and the minimum is 0 degrees/100 m. The directional shear is independent of which way the wind changes with height (i.e., clockwise or counterclockwise). The variable name for use with CHK to alter the range check parameters for the wind direction shear is UADS.

Dew-Point Temperature Gradient - The vertical gradient of dew-point temperature is treated a little differently than the lapse rate and wind shear. Three consecutive values are required for this evaluation. An estimate from the line drawn between the upper and lower points is made at the height of the middle point. The absolute difference between the estimate and the actual dew-point is divided by the height difference between the upper and lower points. This value is compared to the upper and lower bounds defined by UADD. The default upper and lower bounds are 2 °C/100 m and 0 °C/100 m, respectively.

The violations for the lapse rate and shear are tallied into the height category containing the upper height, whereas the dew-point violations are tallied into the height category containing the middle point. Therefore, if none of the data required to perform the gradient calculations are missing, then there are (N-1) checks on lapse rate and shear and (N-2) checks on dew-point, where N represents the number of levels in a sounding.

4.1.2.2 Upper Air Data Modification

By default, some cleanup is performed on the upper air data during the extraction process. This housekeeping involves the following QA procedures:

- Temperature above 1000 m
- Lapse rate

- Redundant level
- Calm conditions
- Missing dry bulb and/or dew-point
- Height of sounding.

The above QA procedures may be deactivated through the use of the optional input image **UA OFF**. The UA OFF image deactivates all of the above actions; there is no way to deactivate individual actions.

Temperature above 1000 m - For heights above 1000 m above ground level (AGL), temperatures greater than 10 °C are checked to insure they have the correct sign. The sign of the temperature immediately below the level in question is checked. If the sign is negative, then the sign of the temperature at the level in question is changed to negative; if the sign is positive or if the temperature is missing, then no action is taken. This action was introduced to reduce the number of sign errors that occur in the TD-5600 format data. The primary emphasis is on levels away from the surface where it is obvious that the signs were in error. No attempt is made here to correct the data near the surface. Checks of temperatures fluctuating around 0 °C are also avoided, where the temperature can switch signs from one level to the next, by only considering temperatures greater than 10 °C.

Lapse rate - If the temperature lapse rate between two levels is superadiabatic, i.e., less than -0.0098 $°Cm^{-1}$, and the lower level temperature is greater than 0 °C, the sign of the lower level temperature is changed. This sign change is not performed if it would create a temperature inversion greater than the maximum defined with the keyword UALR, i.e., the lapse rate upper bound for quality assessment (see Appendix C for default value).

Redundant level - If a mandatory sounding level is within 1 percent of a significant level (with respect to pressure) then the mandatory level is deleted. Because the mandatory levels were originally computed from the data at the significant levels, there is no loss of information in the sounding.

Deleting mandatory levels occurs after the data are retrieved from tape, which results in reducing the number of levels in a sounding. If the maximum number of levels is retrieved, then this process will produce a sounding with fewer than the maximum number of levels, i.e., the processor does not return to the tape to retrieve additional levels. The maximum number of levels that can be retrieved is 20.

Calm conditions - The wind speed and direction at each level are checked to insure that there are no levels with a zero wind speed and a non-zero wind direction. If one is found, the wind direction is set to zero to represent calm conditions.

Missing dry bulb and/or dew-point - If temperature or dew-point at a level is represented by a missing value indicator, then an estimate for the missing observation is made by linearly interpolating to the level in question. The data from the level immediately below and the nearest valid data from above the level in question are used. If data that are required for the interpolation are also missing, then no interpolation is performed.

Sounding heights - The sounding heights on magnetic tape are stored as meters above mean sea level. With the sounding modification actions enabled, the heights are converted to meters above ground level. The first level in a sounding is for the surface. The height at this level is subtracted from all levels including the surface, so that the heights start at 0 m.

If the height is missing at the surface, then a value of zero is assumed in performing the subtractions.

Modifications to an upper air data file are tracked in the Stage 1 error/message file; an example is provided in Figure 4-1. The warning messages that are written if the data are modified include the date and time. The format is YYMMDD/HH where YY = 2-digit year, MM = month (1-12), DD = day (1-31) and HH = hour (1-24). The example error/message report shown in Figure 4-1 indicates that 13 mandatory levels were determined to be redundant and were deleted. In addition, the sign on two temperature values was corrected.

```
12  JB 119   SETUP:  ENCOUNTERED END OF "JOB/RUN CARD"
 0  JB W12  UAQAST:  SUMMARY:  MISSING/ERRORS IN UA-OQA CARD
 0  JB I10    TEST:  SUMMARY:  NO SF-EXT CARD, NULL EXTRACT
 0  JB I11    TEST:  SUMMARY:  NO SF-IQA CARD, NULL QA
 0  JB I12    TEST:  SUMMARY:  NO SF-OQA CARD, NULL MERGE
 0  JB I10    TEST:  SUMMARY:  NO OS-EXT CARD, NULL EXTRACT
 0  JB I11    TEST:  SUMMARY:  NO OS-EXT CARD, NULL QA
 0  JB I12    TEST:  SUMMARY:  NO OS-EXT CARD, NULL MERGE
 0  UA I30   UAEXT:  **** UPPER AIR EXTRACTION ****
 0  UA I36   UAEXT: *     *** AUTOMATIC SDG. CHECKS ARE ON
 0  UA I37  UAAUTO:  64 1 1/ 7; LVL  6 -TEMP. SIGN CHANGE
 1  UA I37  UAAUTO:  64 1 1/19;   450.MB -MAND. LVL DELETED
 1  UA I37  UAAUTO:  64 1 2/ 7;   900.MB -MAND. LVL DELETED
 2  UA I37  UAAUTO:  64 1 2/ 7;   850.MB -MAND. LVL DELETED
 1  UA I37  UAAUTO:  64 1 2/19;   950.MB -MAND. LVL DELETED
 2  UA I37  UAAUTO:  64 1 2/19;   900.MB -MAND. LVL DELETED
 3  UA I37  UAAUTO:  64 1 2/19;   600.MB -MAND. LVL DELETED
 2  UA I37  UAAUTO:  64 1 2/19; LVL  8 -TEMP. SIGN CHANGE
 1  UA I37  UAAUTO:  64 1 3/ 7;   700.MB -MAND. LVL DELETED
 1  UA I37  UAAUTO:  64 1 3/19;   900.MB -MAND. LVL DELETED
 1  UA I37  UAAUTO:  64 1 4/ 7;   850.MB -MAND. LVL DELETED
 2  UA I37  UAAUTO:  64 1 4/ 7;   500.MB -MAND. LVL DELETED
 3  UA I37  UAAUTO:  64 1 4/ 7;   450.MB -MAND. LVL DELETED
 1  UA I37  UAAUTO:  64 1 5/ 7;   950.MB -MAND. LVL DELETED
 1  UA I37  UAAUTO:  64 1 5/19;   900.MB -MAND. LVL DELETED
 6  UA I39  GETMIX:  END-OF-FILE, END-OF-DATA
 0  UA I30   UAEXT:   11 SDGS AND    6 MIXING HTS EXTRACTED
```

Figure 4-1 Example Stage 1 Error/Message Report Tracking Modifications to an Upper Air Data File

4.2 Stage 3 Processing
4.2.1 Wind
4.2.1.1 Default Processing

The default method for handling wind data by MPRM is to use NWS surface observations. The data are hourly and result from observations made at a single level. No input is required for implementation. If the data are missing, then a missing value indicator is written to the output file, and a message is inserted in the error/message file to warn the user that this has occurred.

4.2.1.2 Treatment of Calms

Calm winds are handled somewhat differently for dispersion models requiring hourly meteorological data versus those requiring STAR output. The following calms procedures are used for those models which require unformatted (binary) hourly meteorological data:

NWS Data - For NWS data, if the wind speed is less than 1 ms^{-1}, then the speed is reset to 1 ms^{-1} and the wind direction is set to the last valid, non-randomized wind direction value.

On-site Data - For on-site data, if the wind speed is less than the threshold (OSCALM), then the speed is reset to 1 ms^{-1} and the wind direction is set to the last valid wind direction value. If the on-site wind speed is less than 1 ms^{-1} but greater than or equal to the threshold, the speed is reset to 1 ms^{-1} and the wind direction is accepted as valid. This procedure should not be confused with the procedure for obtaining an hourly averaged wind speed described in Section 4.1.1.

For the formatted (ASCII) output option available with ISCST, the procedures for identifying calms are the same; however, when a calm is detected both the wind speed and wind direction are reset to 'zero'.

For those models requiring STAR output, the occurrences of calm winds are distributed within the lowest wind speed classes in accordance with the directional distribution of non-calm observations within these classes.

4.2.1.3 Measurement Height

As discussed in Section 4, the OS MAP image provides the list of variables available in the on-site data base. The OS MAP image may have include several levels of wind data. In such cases, MPRM needs to be told which level to use in processing the data for use in a dispersion model. This is accomplished using the following input image:

MP VBL WIND ONSITE *stkhgt*

where *stkhgt* is a place holder for the measurement height.

The dispersion models supported by MPRM require only one level of wind data for use in calculating plume rise, and for estimating plume transport and dilution. Applicable guidance (Appendix W to 40 CFR Part 51) recommends that wind measurements representative of stack-top height be used for these estimates. MPRM has been designed to use wind data from the level closest to the value for *stkhgt*. This measurement level is then used in all further processing of wind data. In defining the measurement level, MPRM interrogates the OS MAP input images to insure that wind data are available at this level; processing is stopped if it is determined that no wind data are available. Since any value greater than zero for stkhgt is allowed, the user can specify the level that is best for the given dispersion analysis. This may or may not be the level nearest to the actual height of the stack being modeled, as the data may not be representative for one reason or another, or more likely, the data may not be sufficiently complete at all levels (see guidance on completeness requirements in U.S. EPA, 1987).

Consider the case of on-site wind data being available at 10, 60 and 100 m on a meteorological mast, and the stack height to be modeled is 300 m. The user could include as input during Stage 3 processing:

MP VBL WIND ONSITE 300

MPRM would then process the 100 m wind data, the level closest to 300 m, for generating the modeling output file. What would happen if the 100 m data were only available during a small portion of the period to be analyzed? Perhaps, the instruments at 100 m were damaged and replacement was delayed. Then the input could be modified to force MPRM to select the wind data at a lower level where the observation record is more complete; e.g.:

MP VBL WIND ONSITE 60.

For regulatory applications, such procedures should be cleared with the appropriate authority.

4.2.2 Temperature

4.2.2.1 Default Processing

The default method for processing temperature data is to use NWS surface observations. The data are hourly and result from observations made at a single level. No input is required for implementation. If the data are missing, then a missing value indicator is written to the output file, and a message is inserted in the error/message file to warn the user that this has occurred.

4.2.2.2 Measurement Height

As discussed in Section 4, the OS MAP image provides the list of variables available in the on-site data base. The OS MAP image may include several levels of temperature data. In such cases, MPRM needs to be told which level to use in processing the data for use in a dispersion model. This is accomplished using the following input image:

MP VBL TEMP ONSITE *tmphgt*

where *tmphgt* is a place holder for the measurement height.

Temperature data for use in regulatory dispersion modeling is normally measured at a level representative of the surface layer (nominally 2 m), [U.S. EPA, 1987]. However. depending on the specific applicaton, other levels may be more apropriate. As with multiple levels of wind data, MPRM will use temperature data from the level closest to the value for *tmphgt*.

For example, consider a case involving temperature data at two levels (10 and 100 m). The following input image could be used to specify use of the surface layer temperature:

MP VBL TEMP ONSITE 2

MPRM would then process the 10 m temperature data, the level closest to 2 m, for generating the modeling output file.

4.2.3 Stability

Stability processing in MPRM supports those dispersion models which employ the Gaussian plume algorithm with Pasquill-Gifford (P-G) plume dimensions and stability categories; these models employ P-G stability categories which originally were based on insolation, cloud cover, and 10 m wind speed (Pasquill, 1961). Turner (1964) provided an objective method for estimating P-G stability based on wind speed, cloud cover and ceiling height - data which are routinely available for many airports.

MPRM provides three choices for implementing Turner's method depending on the source of the meteorological data: 1) all airport data; 2) all site specific data; and 3) a mixture of airport and site specific data. Alternative methods for use when representative cloud cover and ceiling observations are not available are also supported. These include a radiation-based method which uses on-site measurements of solar radiation and delta-T (SRDT) and two turbulence-based methods which use on-site wind fluctuation statistics (Sigma-A and Sigma-E).

Detailed guidance on estimating P-G stability is provided in (U.S. EPA, 1987). Turner's (1964) method with site-specific wind speed measurements at or near 10 m and representative cloud cover and ceiling height is preferred for regulatory applications. There is no order of preference for the alternative methods.

A summary of the stability classification methods implemented in MPRM is presented in Table 4-1.

Table 4-1 Stability Classification Methods Implemented in MPRM

Method	MPRM Action	Description
Turner (1964)	NWSWXX	Uses NWS wind speed, ceiling height, and cloud cover (opaque or total)
	ONSITE	Uses on-site wind speed, ceiling height, and cloud cover (opaque or total)
	WNDWXX	Uses on-site wind speed with NWS ceiling height and cloud cover (opaque or total)
SRDT	TTDIFF	Uses on-site wind speed in combination with solar radiation during the day and vertical temperature difference at night
Sigma-E	SESITE	Uses the standard deviation of the elevation angle of the wind vector
Sigma-A	SASITE	Uses the standard deviation of the azimuth angle of the wind vector
	USERIN	Stability category is provided as input

Turner's (1964) method - Turner presented a method for determining Pasquill stability categories from data that are routinely collected at National Weather Service (NWS) stations. The method estimates the effects of net radiation on stability from solar altitude (a function of time of day and time of year), *cloud cover (opaque is preferred, otherwise total if opaque is missing)*, and ceiling height.

Solar radiation/delta-T (SRDT) method - The solar radiation/delta-T (SRDT) method retains the basic structure and rationale of Turner's method while obviating the need for observations of cloud cover and ceiling. The method uses the surface layer wind speed (measured at or near 10 m) in combination with measurements of total solar radiation during the day and a low-level vertical temperature difference (ΔT) at night. The method is based on Bowen et al. (1983) with modifications as necessary to retain as much as possible of the structure of Turner's method. The classification algorithm is empirically based on evaluation results from three different geographic locations (U.S. EPA, 1993).

Sigma-E method - The Sigma-E (σ_E) method is a turbulence-based method which uses the standard deviation of the elevation angle of the wind in combination with the scalar mean wind speed. By default, the wind speed should be measured at 10 m; the method employs a default site roughness of 0.15 m.

Sigma-A method - The Sigma-A (σ_A) method is a turbulence-based method which uses the standard deviation of the wind direction in combination with the scalar mean wind speed. By default, the wind speed should be measured at 10 m; the method employs a default site roughness of 0.15 m.

The wind speed and turbulence data used in stability category determinations should be taken from a near-surface level, nominally 10 m. The user identifies the measurement level to be used on the MP VBL input image.

If the data necessary for the method chosen by the user are missing, MPRM will cycle through the alternative methods in an attempt to estimate the stability. If the stability category can not be determined by any of the methods, then it is encoded as missing for that hour. MPRM maintains a count of the number of hours of data processed for each of the methods and includes this information in the general report file. Specific instances of stability substitutions can be traced through the error/message file, by including the MP TRA input image during Stage 3 processing. Note, since all on-site methods require near-surface wind speed data, if the wind speed is missing, then the stability category will be missing. Furthermore, whenever the σ_E method is attempted, the transformation using σ_w is automatically invoked if MPRM detects that σ_E is missing for the hour.

The default method for stability category determination (NWSWXX), which relies solely on NWS hourly observations, is excluded from use if the primary method of choice is one of the methods that employs on-site data. Since the default method and method 'WNDWXX' differ only in location of wind speed data, use of the default methodology, when on-site data methods are the primary methods of choice, is equivalent to data substitution of off-site wind speed data for missing on-site wind speed data. *By default, MPRM applies a "smoothing algorithm" to the estimated stability categories which restricts changes in stability to no more than one category from hour to hour.*

4.2.4 Mixing Height

The default method for processing mixing height is to use the interpolation scheme employed in the RAMMET meteorological processor, which uses the twice-daily mixing heights from the nearest NWS upper air observation site, coupled with the stability category determined for the hour. This method is described in more detail in the RAM model user's guide (Catalano et al., 1987). The user may also designate the on-site mixing height to be employed. In this case MPRM will use the value for the hour given in the on-site observation.

4.2.5 Surface Characteristics

MPRM provides the means to specify direction-dependent surface characteristics for use in estimating boundary layer parameters (see Section 4.3). The surface characteristics are: albedo, Bowen ratio, surface roughness length (at the measurement site and at the application site), minimum Monin-Obukhov length for stable conditions, fraction of the net radiation absorbed at the ground, and anthropogenic heat flux. Information on specifying these surface characteristics is provided in Section 3.3. The following defaults apply if values are not specified:

Albedo	0.25
Bowen Ratio	0.70
Roughness (measurement site)	0.15 m
Roughness (application site)	0.15 m
Minimum M-O Length	2.00 m
Surface Heat Flux (fraction of net)	0.15
Anthropogenic Heat Flux	0.00 Wm^2

The default values are typical for cultivated land with average moisture and will not apply to all modeling situations.

The roughness length is used in Stage 3 processing to adjust the σ_E and σ_A stability category boundaries, in accordance with guideline recommendations (Appendix W to 40 CFR Part 51; U.S. EPA, 1987). When an attempt is made to determine the stability category for a given hour using one of these on-site methodologies, the wind direction at the lowest level (above 2 m) on the tower is used to define the wind direction sector from which the wind is blowing. The roughness length is then determined given the wind direction sector and the month of the year. See U.S. EPA (1987) for recommendations on estimating site-specific roughness lengths.

4.3 Boundary Layer Parameters

Estimates of the surface friction velocity and Monin-Obukhov length are required for dry and wet deposition and depletion in the ISCST3 dispersion model. The surface friction velocity (u_*) is a characteristic velocity based on (wind) shear stresses at the earth's surface. The Monin-Obukhov length (L) is a stability parameter that relates this velocity to the transport of heat. This section presents the technical aspects of the computations in MPRM. Stull (1988) provides a good introduction to the theoretical basis for estimating these parameters.

The day is divided into two regimes: unstable and stable. The atmosphere is unstable if the time of day is between sunrise and sunset and the transfer of heat is away from the surface. The atmosphere is considered stable if the time of day is between sunset and sunrise (of the next day) and the transfer of heat is toward the earth's surface. The estimation of these parameters for the unstable and stable boundary layer are discussed in the following. Section 4.3.3 discusses the adjustment of these parameters for the application (receptor) site.

4.3.1 Unstable Boundary Layer Parameters

During daytime convective conditions ($L < 0$), the surface of the earth is heated, resulting in an upward transfer of heat. Hourly estimates of this heat flux are required to estimate u_* and L. The estimates for the heat flux here follow the development of Holtslag and van Ulden (1983). The heat flux is estimated directly from measurements of net radiation (if such measurements are available) using equation 4.2. Alternatively, the net radiation is estimated from measurements of solar insolation (if available) and cloud cover using equation 4.6. If such radiation measurements are not available, then the heat flux is estimated from cloud cover, surface temperature, Bowen ratio and albedo as described below.

Once the heat flux is computed, u_* and L are determined through an iterative procedure using surface layer similarity. While u_* and L change with each iteration, the hourly heat flux remains fixed.

A simple equation that expresses the energy balance at the earth's surface is:

$$R_N + Q_f = H + \lambda E + G \tag{4.1}$$

where R_N is the net radiation, Q_f is the anthropogenic heat flux, H is the sensible heat flux, λE is the latent heat flux, and G is the flux of heat into the ground. Each term is expressed as W m^{-2}. The value of G is assumed to be proportional to the left side of Eq. 4.1, i.e., $G = c_g(R_N + Q_f)$, where c_g is the fraction of the net radiation absorbed at the ground, and is specified by the user. Using this estimate for G and the definition of the Bowen ratio, $B_o = H / \lambda E$, which was specified by the user, the following expression for the sensible heat flux, H, is obtained

$$H = \frac{(1.0 - c_g) R_N^*}{1 + \frac{1}{B_o}} \tag{4.2}$$

where $R_N^* = R_N + Q_f$.

The net radiation R_N is estimated from the total incoming solar radiation, R, as

$$R_N = (1 - r) R - I_N \tag{4.3}$$

where r is the user-specified noon-time albedo (dimensionless), and I_N is the net long-wave radiation at the earth's surface as given by Holtslag and van Ulden (1983). The anthropogenic heat flux specified by the user is then added to the net radiation to obtain R_N^*.

In the general case in which clouds are present, R is computed using the following formula proposed by Kasten and Czeplak (1980)

$$R = R_0 (1 + b_1 N^{b_2}) \tag{4.4}$$

where R_0 (W m^{-2}) is the incoming solar radiation at ground level for clear skies, and N is the fractional opaque cloud cover. The empirical coefficients b_1 and b_2 are assigned the values of -0.75 and 3.4, respectively. If cloud cover is missing for a particular hour, then MPRM assumes overcast conditions (i.e., 10/10 cloud cover) and proceeds with the calculations. A warning message is written to the log file to indicate such an occurrence.

The incoming solar radiation for clear skies R_0 is given by

$$R_0 = a_1 \sin\phi + a_2 \tag{4.5}$$

where ϕ is the elevation of the sun above the horizon (degrees), a_1 = 990 W m^{-2} and a_2 = -30 W m^{-2}. The constants a_1 and a_2 account for attenuation of the short wave radiation by water vapor and dust in the atmosphere. The values used in MPRM are appropriate for mid-latitudes (Holtslag and van Ulden, 1983).

Substituting Eqs. 4.4 and 4.5 into Eq. 4.3 and parameterizing the net long-wave radiation as a function of temperature and cloud cover, Holtslag and van Ulden (1983) estimate the net radiation as

$$R_N = \frac{(1 - r)R + c_1 T^6 - \sigma_{SB} T^4 + c_2 N}{1 + c_3} \tag{4.6}$$

where $\sigma_{SB} = 5.67 \times 10^{-8}$ W m^{-2} K^{-4} is the Stefan-Boltzmann constant, and the other empirical constants are as follows:

$c_1 = 5.31 \times 10^{-13}$ W m^{-2} K^{-6},
$c_2 = 60$ W m^{-2},
$c_3 = 0.12$.

An empirical expression for the albedo as a function of solar elevation angle is given by:

$$r = r' + (1 - r')\, e^{a\nu + b} \tag{4.7}$$

where r' is the surface albedo (dimensionless) for the sun on the meridian specified by the user, ν is the solar elevation angle in degrees, $a = -0.1$, and $b = -0.5\,(1 - r')^2$.

MPRM next computes the surface friction velocity u_* and the Monin-Obukhov length L for the unstable atmosphere through an iterative procedure that is similar to the technique used in the METPRO processor (Paine, 1987). The two equations for u_* and L used in the iteration algorithm are:

$$u_* = \frac{k\,U}{\ln\left(\dfrac{z_{ref}}{z_o}\right) - \Psi + \Psi_o} \tag{4.8}$$

and

$$L = -\frac{\rho\, c_p\, T\, u_*^3}{k\, g\, H} \tag{4.9}$$

where:

H is the sensible heat flux at the surface (W m^{-2}),
k is the von Karman constant,
U is the wind speed (m s^{-1}),
z_{ref} is the anemometer height (m),
z_o is the surface roughness at the measurement site (m) specified by the user,
ρ is the density of dry air (kg m^{-3}),
c_p is the specific heat capacity of air (1004 J kg^{-1} K^{-1}),
T is temperature (K), and
g is the acceleration due to gravity (9.81 m s^{-2}).

The values for Ψ and Ψ_0 (Lumley and Panofsky, 1964; Businger, 1973) are:

$$\frac{+\ \mu}{2}\Bigg) \ + \ \ln\left(\frac{1 + \mu^2}{2}\right) \ - \ 2\tan^{-} \qquad (4.10)$$

$$\frac{+\ \mu_o}{2}\Bigg) \ + \ \ln\left(\frac{1 + \mu_o^2}{2}\right) \ - \ 2\tan \qquad (4.11)$$

where

$$\mu \ = \ (\ 1 \ - \ 16 z_{ref} \ / \ L \ )^{1/4} \qquad (4.12)$$

$$\mu_o \ = \ (\ 1 \ - \ 16 z_o \ / \ L \ )^{1/4} \qquad (4.13)$$

This procedure requires an initial guess for u_*, which is found by initially setting Ψ and Ψ_o to zero. The iteration continues until consecutive values of L differ by 1% or less.

4.3.2 Stable Boundary Layer Parameters

The calculations of u_* and L for the stable atmosphere (L > 0) are based on an approach outlined by Venkatram (1980). The approach does not require an iterative procedure as used for the unstable atmosphere. Estimates of u_* and θ_* (a temperature scale) are made from cloud cover, wind speed and temperature. This, in turn, provides an estimate of the heat flux, and L is computed directly from Eq. 4.9.

The method begins with the following estimate for θ_*:

$$\theta_* \ = \ 0.09(1 \ - \ 0.5 N^2) \qquad (4.14)$$

where N is the fraction of opaque cloud cover. The neutral drag coefficient, C_D (dimensionless), is calculated as

$$C_D = \frac{k}{\ln(z_{ref} / z_o)} \; . \tag{4.15}$$

The friction velocity is determined from

$$'_D U/2 \quad (1 + (1 - (2u_o / (C \tag{4.16}$$

where

$$u_o = \sqrt{\frac{\beta_m z_{ref} g \theta_*}{T}} \tag{4.17}$$

and β_m = 4.7 is a dimensionless constant.

To obtain real-valued solutions for u_*, the following must hold

$$\frac{4u_o^2}{C_D U^2} \le 1 \tag{4.18}$$

If this condition holds, then u_* is computed from Eq. 4.16; if this condition does not hold (under very stable conditions), then the solution to the quadratic equation is imaginary, and a slightly different approach is taken.

Equality in the above condition corresponds to a critical (minimum) wind speed, U_{cr}, for which a real-valued solution to Eq. 4.16 is

$$U_{cr} = \sqrt{\frac{4 \beta_m z_{ref} g \theta_*}{T C_D}} \; . \tag{4.19}$$

For this value, there is a corresponding friction velocity, u_{*cr}, such that

$$u_{*cr} = \frac{C_D U_{cr}}{2}. \tag{4.20}$$

For wind speeds less than this critical value, Eq. 4.16 no longer yields a real-valued solution, and it is desirable to have $u_* \to 0$ as $U \to 0$. Therefore, for $U < U_{cr}$, u_{*cr} is scaled by the ratio U / U_{cr}, and u_* is calculated as

$$u_* = u_{*cr} \frac{U}{U_{cr}} \tag{4.21}$$

For $U < U_{cr}$, van Ulden and Holtslag (1985) showed that there is a nearly linear variation of θ_* with u_*. Therefore, θ_* is similarly scaled as

$$\theta_* = \theta_{*cr} \frac{u_*}{u_{*cr}} \tag{4.22}$$

With the u_* from Eq. 4.16 or 4.21 and the θ_* from Eq. 4.14 or 4.22, the heat flux H is computed as

$$H = -\rho c_p u_* \theta_* \quad . \tag{4.23}$$

Finally, using these estimates of u_* and H, L is computed from Eq. 4.9.

In the case of strong winds, H may become unrealistically large. Therefore, a limit of -64 W m^{-2} is placed on the heat flux, which forces a limit on the product $u_*\theta_*$. This yields a cubic equation in u_*, which is solved to obtain a new u_*. With this new value for u_* and H = -64 W m^{-2}, L is recomputed from Eqs. 4.9 and 4.23 as:

$$L = T u_* / (k g \theta_*).$$

If the value of the Monin-Obukhov length is less than the minimum value specified by the user, then L is reset to this minimum value and a new value for u_* is computed.

4.3.3 Parameters at the Application Site

The discussion above focused on the estimates at the measurement site. Typically, the measurement site is not the location where the output meteorological data from MPRM are to be applied. Dry deposition estimates are sensitive to the value of the friction velocity. Therefore, the friction velocity and Monin-Obukhov length estimated for the measurement site are adjusted to represent the site where the output is to be applied. With the surface roughness length entered by the user for the application site and the estimates of u_* and L at the measurement site, u_* and L representative of the application site are estimated and written to the output file.

Walcek et al. (1986) suggest that near the surface

$$u_1 u_{*1} \approx u_2 u_{*2}$$

for changes in the underlying surface roughness, where the subscripts 1 and 2 represent the previous and current estimates. MPRM incorporates this approach to estimate u_* and L at the application site.

With the roughness length representative of surface conditions at the application site, a new estimate for u_* is obtained through an iterative process using surface layer similarity. The Monin-Obukhov length is obtained from

$$L_2 = L_1 \, (u_{*2}/u_{*1})^3$$

(on the first iteration, the subscript 1 represents the value at the measurement site). When two consecutive estimates of u_* are within 1%, then the process stops.

SECTION 3

PROCESSING - STAGE 3

The goal of Stage 3 processing is to construct a meteorological data file for use with a user selected dispersion model. As a minimum, the input runstream for Stage 3 needs to provide the names for the input file (i.e., the merge output file from Stage 2), the output file, and the dispersion model. General instructions on preparing the input runstream for Stage 3 processing are provided using an example test case in Section 3.1. Subsequent sections provide more specific instructions on: selection of processing options (Section 3.2); and selection of surface characteristics (Section 3.3). Information on the Stage 3 general report and error/message files is provided in Sections 3.4 and 3.5, respectively.

3.1 Example Test Case

An example run stream for processing a merged data file for use in wet deposition modeling is presented in Table 3-1. New keywords introduced in this example are: **SFC** on the OS pathway and **MET**, **MMP**, and **VBL** on the MP pathway. The OS and MP pathway input images are described in Sections 3.1.1 and 3.1.2 respectively.

3.1.1 OS Pathway Input

The **OS SFC** images provide necessary information on surface characteristics for use in estimating boundary layer parameters. The first such record indicates that surface characteristics will be specified by season for 2 sectors; the next two records provide the beginning and ending azimuth (degrees) for these sectors. Records containing the 'VALUES' character string provide the surface characteristics.

The syntax of the **OS SFC SETUP** image is:

OS SFC SETUP parm1 parm2

The parm1 field is a place holder for frequency which must be one of the following character strings: ANN[UAL], SEA[SONAL], or MON[THLY]; the frequency indicates that the surface characteristics are constant over an annual cycle, or vary by season or calendar month. The brackets indicate that only the first three letters of the character string are required. The parm2 field is a place holder for the number of sectors (maximum 12). The sectors should be contiguous and should cover 360°. To define a single value for each of the site characteristics, the frequency should be specified as ANNUAL and the number of sectors should be 1.

The syntax of the **OS SFC SECTORS** image is:

OS SFC SECTORS parm1 parm2 parm3

Parm1 is the sector number; parm2 is the beginning azimuth (included in the sector), and parm3 is the ending azimuth (excluded from the sector). The azimuth is defined in a clockwise sense; a sector definition may pass through north (360°) without having to terminate at north. The number of 'OS SFC SECTORS' images must correspond to the number of sectors.

The syntax of the **OS SFC VALUES** image is:

OS SFC VALUES parm1 parm2 parm3 ... parm9

The **VALUES** character string indicates that information on surface characteristics follows. Parm1 is the frequency index (1 for annual, 1-4 for season, or 1-12 for monthly) and parm2 is the sector index. Seasons are defined in MPRM as follows: Winter = December, January and February (parm1 = 1); Spring = March, April, and May (parm1 = 2); Summer = June, July, and August (parm1 = 3); Fall = September, October, and November (parm1 = 4). The order and defaults for the surface characteristics (parm3 ... parm9) are:

Albedo	0.25
Bowen Ratio	0.70
Roughness Length (measurement site)	0.15 m
Roughness Length (application site)	0.15 m
Minimum Monin-Obukhov Length	2.00 m
Surface Heat Flux (fraction of net)	0.15
Anthropogenic Heat Flux	0.00 Wm^{-2}

Information on specifying surface characteristics is provided in Section 3.3.

3.1.2 MP Pathway Input

The **MP MET** image identifies the merge data file to be processed (MERGE.223) and provides the number of integer hours to be subtracted from the Greenwich Mean Time (GMT) to convert to local standard time (LST). For a west coast location, the conversion is 8 hours.

The **MP MMP** image defines the name for the processed meteorological data file (TEST324.OUT) and selects a dispersion model (ISCSTWET). The default, if no model is specified, is the ISCST3 model; the output in this case is an ASCII file formatted for use in ISCST3. Detailed information on file formats for the dispersion models supported by MPRM is provided in Appendix F.

The syntax for the **MMP** keyword is:

MP MMP DISK filename model

where filename is the name of the output file and model specifies the dispersion model. The filename should not exceed 48 characters and must conform to the file naming conventions appropriate to the computing platform. The dispersion models supported by MPRM are listed in Table 3-2.

The **MP VBL** images specify processing options to be employed for the indicated meteorological variables. The syntax of the **MP VBL** image is:

MP VBL item action parm1 parm2

Information for completing the item, action, and parameter fields is given in Table 3-3. The **item** field refers to the meteorological variable: wind speed and direction (WIND);

temperature (TEMP); mixing height (MHGT) and stability (STAB). The **action** field refers to type of data to be used; the choices are NWSWXX for NWS airport data (the default) and ONSITE for user collected, site specific data. For stability, the action field additionally indicates the method employed to estimate stability. The **parm1** field is a place holder for the measurement height for the WIND, TEMP, and STAB items. The **parm2** field has meaning only for user specified stability (see Section 3.2 for details). In the Table 3-1 example, onsite data are specified for wind and temperature, and TTDIFF processing is specified for stability. There is no MP VBL image for mixing heights; therefore, by default, mixing heights are based on NWS airport data. Selection of processing options for meteorological variables is discussed in Section 3.2. The scientific basis for these options are discussed in Section 4.

The **MP TRA** image activates tracing and currently has meaning only with the determination of the Pasquill stability category. As is described in Section 4, there are six different methodologies available for specifying the stability category: one is equivalent to the RAMMET processor and employs only NWS data, the other five employ on-site data. Since all of the on-site data methods are acceptable, MPRM searches for an alternate on-site method if the primary method is incapable of working for a given hour due to lack of data. The TRA option reports the results of such searches whenever they occur. If these searches were to occur frequently, the error/message file might well become quite large. Therefore, indiscriminate use of the trace option is not recommended. A better use of the TRA option would be to process short periods of record that are known to contain frequent periods of missing data. The MP EXT input can be used to control the dates processed. In this manner, the search results can be reviewed in a manageable fashion. Obviously, if an alternate method for specifying the stability category is employed too often, it may invalidate the use of the data for certain regulatory actions.

The **MP LST** image activates the listing of the generated meteorological data to the general report file and, like the **MP TRA** image, enhances the detail provided in the Stage 3 processing messages. The extra output produced by these two options are of little concern if only several days of data are being processed. If a longer record is involved, e.g., a 1-year period, one might question the wisdom of employing these options. The **MP LST** image will generate one full page of output for each 2 to 3 days of data depending on the dispersion model.

3.2 Processing Options

Default selections for processing wind, temperature, stability category, and mixing height employ the NWS hourly surface weather observations and twice-daily estimated mixing heights. The default selections duplicate the procedures employed by the RAMMET meteorological processor. In MPRM, the defaults can be overridden using the **MP VBL** input image. The syntax for this image is:

```
MP  VBL  ITEM  ACTION  XXXX  X
          |     |       |    |
          |     |       |    └── Input needed only with
          |     |       |         Item "STAB" and Action
          |     |       |         "USERIN"
          |     |       |
          |     |       └──────── Additional input,
          |     |                   as required
          |     |
          |     └──────────────── 6-character keyword
          |                         instructing processor
          |                         on how ITEM is to be
          |
```

```
                                        accomplished

                                     4-character keyword
                                        defining process
                                        (methodology)
```

Table 3-3 describes the allowable character strings for **ITEM** and **ACTION** and provides other necessary information for completing the MP VBL image.

3.3 Surface Characteristics

MPRM provides the means to specify direction-dependent surface characteristics for use in estimating boundary layer parameters. If none are specified, the default values given in Section 3.1 are used. The default values are typical for cultivated land with average moisture and, consequently, will not apply to all modeling situations. Information on specifying site specific values for surface characteristics is provided in the following.

Albedo - The albedo is the fraction of the incoming solar radiation that is reflected from the ground when the sun is directly overhead. Adjustments are made automatically within MPRM for the variation in the albedo with solar elevation angle. Typical values range from 0.1 for thick deciduous forests to 0.65 for fresh snow. A range of values is given in Table 3-4 as a function of several land-use types and season. The default value in MPRM is 0.25.

Bowen Ratio - The Bowen ratio is an indicator of the amount of moisture at the surface and is defined by H/LE, where H is the upward sensible heat flux and LE is the latent heat flux used in evaporation. The presence of moisture at the earth's surface alters the energy balance, which in turn alters the sensible heat flux and Monin-Obukhov length. The Bowen ratio varies from 0.1 over water to 10.0 in desert. A range of values is given in Table 3-5 as a function of land-use type, season and moisture condition. The default value for Bowen ratio is 0.75.

Roughness Length - The surface roughness length (Z_0) is, in principle, the height at which the wind speed vanishes; it is generally proportional to the physical dimensions of the roughness elements. Roughness length values range from less than 1 cm over a calm water surface to 1 m or more over a forest. Typical values for a range of land-use types as a function of season are listed in Table 3-6. MPRM expects surface roughness information to be provided for two types of sites: the measurement site, and the application site.

Measurement Site - The surface roughness at the measurement site is used internally in MPRM for scaling meteorological variables within the surface layer based on a single surface layer measurement (nominally the 10 m level). The measurement site refers to the site of the meteorological measurements. If the meteorological data have been collected in accordance with recommendations in (U.S. EPA, 1987), this should not be a problem since the site characteristics will have been fully documented. If such documentation is not available, one should assess surface characteristics within a one kilometer radius of the measurement site and use the information in Table 3-6 to determine the appropriate roughness length. For NWS data, a default value of 0.15 m should be used.

Application Site - The surface roughness at the application (receptor) site is needed for modeling applications involving estimates of dry deposition and depletion; the surface roughness at the application site is not used internally within MPRM, but is passed along directly to the meteorological input file for the model selected. One should not expect that the surface characteristics of the measurement site will necessarily be representative of the application site; in fact, often this will not be the case. The surface roughness length at the application site is used to obtain estimates of the surface friction velocity (u_*) and Monin-Obukhov length (L) at the application site.

Monin-Obukhov Length - The Monin-Obukhov length is a measure of atmospheric stability. It is negative during the day when surface heating results in an unstable atmosphere and positive at night when the surface cools (stable atmosphere). Values near zero indicate very unstable or stable conditions (depending on the sign). In urban areas during stable conditions, the estimated value of L may not adequately reflect the less stable boundary layer. Hanna and Chang (1991) point out that mechanical turbulence generated by obstacles (buildings) in urban areas will tend to produce a "more neutral" surface layer than that over an unobstructed site. They suggest that a minimum value of L be set for stable hours in order to simulate this effect. Using an approximate relation between obstacle height and the zone of flow affected by an obstacle, they suggest the following minimum values for several urban land use classifications:

agriculture (open)	2 m
residential	25 m
compact residential/industrial	50 m
commercial (19-40 story buildings)	100 m
(> 40 story buildings)	150 m

Surface Heat Flux - The flux of heat into the ground during the daytime is parameterized as a fraction of the net radiation. Values suggested by Oke (1982) are:

rural	0.15
suburban	0.22
urban	0.27

Anthropogenic Heat Flux - The anthropogenic heat flux can usually be neglected (set equal to zero) in areas outside highly urbanized locations. However, in areas with high population densities or high energy use, this flux may not always be negligible. Oke (1978) presents estimates of population density and per capita energy use for 10 cities and obtains a heat flux for each. Summertime values are typically 50% of the mean, while wintertime values are about 150% of the mean in the colder climates. Table 3-7 provides values for several urban areas.

The surface characteristics used in the example test case are based on an assumed modeling scenario involving a source located on the boundary separating an urban area from a deciduous forest. The two land use types are assumed to occupy contiguous 180 degree sectors. Table 3-8 provides a summary the surface characteristics by season for these two land use types.

3.4 Stage 3 General Report File

The Stage 3 general report is structured somewhat differently than that generated during Stages 1 and 2. If the **LST** keyword has been activated, then the first page of the general report will echo the header information that was written to the output file (i.e., the file defined following the MMP keyword). This would be followed by the listing of the generated meteorological data. The listing would continue for as many pages as necessary. The rest of the Stage 3 general report is standard; an example is shown in Figure 3-1. The general report documents Stage 3 processing under 11 headings as follows:

1. Filenames as determined in setup
2. Dispersion model defined in setup
3. Processing options selected
4. Stability methods used
5. Processing assumptions
6. Locations specified in setup
7. Output file names
8. Summary of data processing results
9. Distribution of wind speeds
10. Rural stability category results
11. Surface characteristics used

The information contained under the first two headings is self-explanatory. Notes related to the information contained under the remaining headings is provided in the following:

Processing options selected - This item documents the processing options as selected during setup (see Table 3-3 and discussion in Section 3.2). The example documented in Figure 3-1 indicates that on-site data were specified for wind and temperature, and TTDIFF processing was specified for stability. By default, NWS airport data were used for mixing heights.

Stability methods used - Six methods for estimating the P-G stability category are provided in MPRM. The six methods are considered to be equivalent; consequently, if data for the method specified in the MP VBL STAB image are not available, MPRM will attempt to process stability using one or more of the remaining alternative methods. If all of the methods are exhausted, MPRM will write a message to the error/message file indicating that stability processing could not be completed for the indicated hour. The example documented in Figure 3-1 indicates that the TTDIFF method was employed successfully in estimating stability for 719 records (hours).

Processing assumptions - Item 5 of the general report documents the measurement heights for the meteorological variables used in creating the meteorological data file. This information is especially important when on-site data are being processed because multiple measurement levels may be involved. As discussed in Section 3.2, when data for multiple levels are available, MPRM will select the level closest to the value provided in the associated MP VBL image. The example documented in Figure 3-1 indicates that wind speed data, used for stability category estimates, are based on 10-m measurements; wind speed and direction data, for use in transport, are based on 10-m measurements; and temperature data, for use in plume rise calculations etc., are based on measurements made at 2 m.

Locations specified in setup - Item 6 of the general report documents the location information (station identifier, latitude, and longitude) associated with each of the sources of meteorological data in the merged file. The latitude and longitude for the NWS surface and upper air data are provided for information only, since Stage 3 processing assumes that the location information provided for the on-site data are to be used in processing. The latitude and longitude are used in MPRM to calculate the elevation of the sun with respect to the horizon and, in turn, the time of sunrise and sunset. The latter are important in processing routines for estimating the P-G stability category.

Output file names - The seventh item in the general report provides documentation related to the output from Stage 3. This includes the file names for the error/message file and the output meteorological data file for use in modeling. The header record on the output file is also listed. This normally contains the station identifiers and year for the surface and upper air data; some models use this information to verify that the meteorological data file being used is consistent with that which was requested in the model input.

Summary of data processing results - The eighth item in the general report lists the number of valid and invalid (missing) records for each meteorological variable in a standard output file. The example in Figure 3-1 shows that 720 records (hours) were processed and that there were 719 valid data values for each of the six variables (stability, wind speed, wind direction, rural mixing height, urban mixing height, and temperature); note, calms are regarded as valid wind speeds. Normally, invalid (missing) records should be resolved following the completion of Stage 1 processing; thus, one would normally not expect to find missing data showing up in Stage 3. In this case, at least one and perhaps as many as six bad records slipped through the cracks. These records should be corrected prior to the use of these data in regulatory dispersion modeling.

Distribution of wind speeds - The ninth item in the general report provides information on the distribution of wind speeds in the data base. The information provided is the frequency of occurrence (number of hours) and the harmonic average wind speed (ms^{-1}) for six wind speed ranges (0-3, 4-6, 7-10, 11-16, 17-21, and > 21 kts).

Stability category results - Item ten in the general report provides information on the distribution of P-G stability category estimates.

Surface characteristics used - Item eleven in the general report documents the surface characteristics used in stage 3 processing. As indicated in Table 3-8, the surface characteristics used in the example vary with season of the year and direction sector (land use type).

3.5 Stage 3 Error/Message File

The user has two means to amplify the information provided in the general report. First, the meteorological data stored in the output file for the dispersion model can be listed to the general report file. This is accomplished by use of the JB LST input. Second, more detailed messages can be obtained in the error/message file. This is accomplished using the UA TRA, SF TRA, OS TRA, or MP TRA input image.

Figure 3-2 presents a partial listing of an error/message file associated with the following Stage 3 input image:

MP TRA STAB

The following images from the error/message file indicate that there was insufficient data to compute a stability category for hour 23 on Julian day 365:

```
365 MP T75 OS1PGT: ISPD MISSING, HR 23 PGSTAB .EQ. 0
365 MP T75 OSSEPG: ISPD MISSING, HR 23 PGSTAB .EQ. 0
365 MP T75 OSSAPG: ISPD MISSING, HR 23 PGSTAB .EQ. 0
365 MP T75 OS2NWS: ISPD MISSING, HR 23 PGSTAB .EQ. 0
365 MP T75 SFSTAB: HOUR 23 NO PG CATEGORY POSSIBLE
```

In the first image, 365 is the record number in the output file, MP is the pathway, T75 is the message number (see Appendix E), and OS1PGT is the name of the subroutine which generated the message. The subroutine identifies the stability processing method; these are listed for reference in Table 3-9. Translated the message reads 'wind speed (ISPD) was missing for hour 23 and thus, the P-G stability category was set to zero (i.e., missing)'. The next three images are translated similarly, only the subroutine is changed. Taken together the first four images show that four different subroutines were called in an attempt to determine a stability category and all failed due to a missing value for wind speed. The last (fifth) image indicates that all acceptable techniques for estimating the P-G stability have been exhausted.

Note, for hour 24 (see Figure 3-2), the search ended in subroutine OSSAPG, where it was determined that sufficient data were present to employ the SASITE option for computing stability category.

Table 3-1

Runstream for Processing NWS and On-site Data for use in Wet Deposition Modeling

JB	STA		Start JB input
JB	OUT	DISK TEST324.RPT	Defines name for general report file
JB	ERR	DISK TEST324.ERR	Defines name for error report file
JB	FIN		Finish JB input
OS	STA		Start OS input
OS	LOC	LAFAYE 122.60W 45.50N 0	Defines on-site location
OS	**SFC**	SETUP SEASON 2	Specifies seasonal surface characteristics for 2 sectors
OS	**SFC**	SECTORS 1 0 180	Defines bounds for sector 1
OS	**SFC**	SECTORS 2 180 360	Defines bounds for sector 2
OS	**SFC**	VALUES 1 1 0.50 1.50 0.15 0.50 2.00 0.15 0.0	Data for season 1, sector 1
OS	**SFC**	VALUES 2 1 0.12 0.70 0.15 1.00 2.00 0.15 0.0	Data for season 2, sector 1
OS	**SFC**	VALUES 3 1 0.12 0.30 0.15 1.30 2.00 0.15 0.0	Data for season 3, sector 1
OS	**SFC**	VALUES 4 1 0.12 1.00 0.15 0.80 2.00 0.15 0.0	Data for season 4, sector 1
OS	**SFC**	VALUES 1 2 0.35 1.50 0.15 1.00 50.00 0.27 0.0	Data for season 1, sector 2
OS	**SFC**	VALUES 2 2 0.14 1.00 0.15 1.00 50.00 0.27 0.0	Data for season 2, sector 2
OS	**SFC**	VALUES 3 2 0.16 2.00 0.15 1.00 50.00 0.27 0.0	Data for season 3, sector 2
OS	**SFC**	VALUES 4 2 0.18 2.00 0.15 1.00 50.00 0.27 0.0	Data for season 4, sector 2
OS	FIN		Finish OS input
MP	STA		Start MP input
MP	**MET**	DISK MERGE.223 8	Provides name of merge file to process
MP	**MMP**	DISK TEST324.OUT ISCSTWET	Defines output file name and dispersion model
MP	**VBL**	WIND ONSITE 10	Defines processing options for wind speed and direction
MP	**VBL**	TEMP ONSITE 2	Defines processing options for temperature
MP	VBL	STAB TTDIFF 10	Defines processing options for stability
MP	TRA		Activates trace procedures
MP	LST		Activates listing of data to general report file
MP	FIN		Finish MP input

Table 3-2

Dispersion Models Supported by MPRM

MMP Model Option	Dispersion Model Name	Description
ISCST	ISCST	The ISCST model option results in an ASCII file for use in ISCST; this is the default. The default output consists of ten fields ending with the mixing heights (see Appendix F).
ISCSTDRY	ISCST	ISCSTDRY produces an ASCII file for use in modeling dry deposition with ISCST. Each record includes three additional fields following the mixing height: surface friction velocity, Monin-Obukhov length and surface roughness length at the application site.
ISCSTWET	ISCST	ISCSTWET produces an ASCII file for use in wet deposition modeling with ISCST. Each record includes five additional fields following the mixing height: surface friction velocity, Monin-Obukhov length, surface roughness length at the application site, precipitation type and precipitation amount.
BLP COMPLEX1 RAM	BLP COMPLEX1 RAM	Selection of these models results in a RAMMET binary output file with 24 hours of data per record. The same file also supports the unformatted (binary) option of ISCST.
CALINE-3	CALINE-3	This selection results in an ASCII file for use in CALINE-3. This format has 1 hour of data in each record.
RTDM	RTDM	This selection results in an ASCII file for use in RTDM. This format has 1 hour of data in each record.
VALLEY ISCLT CDM16*	VALLEY ISCLT CDM 2.0*	This selection results in an ASCII file containing data describing the joint frequency distribution of wind direction and wind speed by stability class. Sixteen wind direction sectors are used in developing the frequency distribution, with the first 22.5° sector centered on winds from the North.
CDM36*	CDM 2.0*	This selection results in an ASCII file containing data describing the joint frequency distribution of wind direction and wind speed by stability class. Thirty-six wind direction sectors are used in developing the frequency distribution, with the first 10° sector centered on winds from the North.

* The CDM 2.0 dispersion model can process meteorological frequency function data (often referred to as STability ARray data, STAR), constructed using either 16 or 36 wind direction sectors. To provide this flexibility, we have used CDM16 and CDM36 to identify whether 16 or 36 wind direction sectors are desired in constructing the STAR data. STAR output for CDM use the six stability categories A, B, C, D-day, D-night, E-F. STAR output for the ISCLT and VALLEY models use the six stability categories: A, B, C, D, E, F.

Table 3-3

Information for Selecting Processing Options on the MP VBL Input Image

Item	Action	Description
WIND	**NWSWXX**	**[Default]** The wind direction and speed are determined using the wind direction and speed given in the hourly NWS weather observation. As the observations are reported to the nearest 10°, a standard set of random numbers is used, as in RAMMET, for randomizing the wind directions.
	ONSITE	Additional input is a value for STKHGT. Wind direction and speed are determined from on-site observations. Values selected are from on-site tower level nearest to value given for STKHGT.
TEMP	**NWSWXX**	**[Default]** The temperature is determined using the values given in the hourly NWS weather observation.
	ONSITE	Additional input is a value for TMPHGT. Temperature is determined from on-site observations. Values selected are from on-site tower level nearest to value given for TMPHGT.
MHGT	**NWSWXX**	**[Default]** The mixing height is determined using the NCDC twice-daily mixing height values and the stability category for the hour. The procedure is that employed in RAMMET.
	ONSITE	The mixing height given in the hourly on-site observation is used.
STAB	**NWSWXX**	**[Default]** The stability category is determined using the cloud cover, ceiling height, and wind speed (from NWS weather observations) coupled with sun's position. The procedure is that employed in RAMMET. An optional additional input is a value for ANEHGT (the default is 10 m).
	ONSITE	Additional input is a value for ANEHGT. The stability category is determined using the same procedure as NWSWXX, with all data taken from the on-site observation. Wind Speed values are from on-site tower level nearest to value given for ANEHGT.
	SESITE	Additional input is a value for ANEHGT. The stability category is determined using standard deviation of vertical wind direction fluctuations at tower level nearest to value given for ANEHGT.
	SASITE	Additional input is a value for ANEHGT. The stability category is determined using standard deviation of horizontal wind direction fluctuations at tower level nearest to value given for ANEHGT.
	USERIN	Additional input is a value for ANEHGT and [ISCVAR = 1, 2, or 3]. This action indicates that the user is providing the stability directly in the variable US01 (when ISCVAR = 1).
	WNDWXX	Additional input is a value given for ANEHGT. The stability category is determined using on-site wind speed from tower level nearest to ANEHGT, and NWS observations of cloud amount and ceiling height.
	TTDIFF	TTDIFF Additional input is a value for ANEHGT. The stability category is determined using the solar radiation temperature difference method.

Table 3-4

Albedo[1] of Natural Ground Covers by Land Use and Season (from Iqbal, 1983)

	Land-Use Type	Winter[2]	Spring	Summer	Autumn
1.	Water Surface	0.20	0.12	0.10	0.14
2.	Deciduous Forest	0.50	0.12	0.12	0.12
3.	Coniferous Forest	0.35	0.12	0.12	0.12
4.	Swamp	0.30	0.12	0.14	0.16
5.	Cultivated Land	0.60	0.14	0.20	0.18
6.	Grassland	0.60	0.18	0.18	0.20
7.	Urban	0.35	0.14	0.16	0.18
8.	Desert Shrubland	0.45	0.30	0.28	0.28

Definitions of Seasons:

Winter: Periods when surfaces were covered by snow, and when temperatures are sub-freezing (defined as December, January, and February in MPRM).

Spring: Periods when vegetation is emerging or partially green. This is a transitional situation that applies for 1-2 months after the last killing frost in spring (defined as March, April, and May in MPRM).

Summer: Periods when vegetation is lush and healthy, typical of mid-summer, but also of other seasons where frost is less common (defined as June, July, and August in MPRM).

Autumn: Periods when freezing conditions are common, deciduous trees are leafless, crops are not yet planted or are already harvested (bare soil exposed), grass surfaces are brown, and no snow is present (defined as September, October, and November in MPRM).

[1] See also Iqbal (1983) for specific crops or ground covers.

[2] Winter albedo depends upon whether a snow cover is present continuously, intermittently, or seldom. Albedo ranges from about 0.30 for fresh snow cover to about 0.65 for continuous cover.

Table 3-5

Daytime Bowen Ratio by Land Use and Season (from Paine, 1987)

Dry Conditions

Land-Use	Winter	Spring	Summer	Autumn
Water (fresh and sea)	2.0	0.1	0.1	0.1
Deciduous Forest	2.0	1.5	0.6	2.0
Coniferous Forest	2.0	1.5	0.6	1.5
Swamp	2.0	0.2	0.2	0.2
Cultivated Land	2.0	1.0	1.5	2.0
Grassland	2.0	1.0	2.0	2.0
Urban	2.0	2.0	4.0	4.0
Desert Shrubland	10.0	5.0	6.0	10.0

Average Conditions

Land-Use	Winter	Spring	Summer	Autumn
Water (fresh and sea)	1.5	0.1	0.1	0.1
Deciduous Forest	1.5	0.7	0.3	1.0
Coniferous Forest	1.5	0.7	0.3	0.8
Swamp	1.5	0.1	0.1	0.1
Cultivated Land	1.5	0.3	0.5	0.7
Grassland	1.5	0.4	0.8	1.0
Urban	1.5	1.0	2.0	2.0
Desert Shrubland	6.0	3.0	4.0	6.0

Wet Conditions

Land-Use	Winter	Spring	Summer	Autumn
Water (fresh and sea)	0.3	0.1	0.1	0.1
Deciduous Forest	0.5	0.3	0.2	0.4
Coniferous Forest	0.3	0.3	0.2	0.3
Swamp	0.5	0.1	0.1	0.1
Cultivated Land	0.5	0.2	0.3	0.4
Grassland	0.5	0.3	0.4	0.5
Urban	0.5	0.5	1.0	1.0
Desert Shrubland	2.0	1.0	5.0	2.0

Table 3-6

Surface Roughness Length (m) by Land Use Type and Season (from Sheih et al., 1979)

	Land-Use Type	Winter	Spring	Summer	Autumn
1.	Water Surface	0.0001	0.0001	0.0001	0.0001
2.	Deciduous Forest	0.50	1.00	1.30	0.80
3.	Coniferous Forest	1.30	1.30	1.30	1.30
4.	Swamp	0.05	0.20	0.20	0.20
5.	Cultivated Land	0.01	0.03	0.20	0.05
6.	Grassland	0.001	0.05	0.10	0.01
7.	Urban	1.00	1.00	1.00	1.00
8.	Desert Shrubland	0.15	0.30	0.30	0.30

Table 3-7

Average Anthropogenic Heat Flux (Q_f) and Net Radiation (Q_*) for Several Urban Areas (from Oke, 1978)

Urban area/ latitude/period	Population ($x\ 10^6$)	Population density (persons/km^2)	Per capita energy usage (MJx10^3/yr)	Q_f (W/m^2)	Q_* (W/m^2)
Manhattan (40°N)					
annual	1.7	28,810	128	117	93
summer				40	
winter				198	
Montreal (45°N)					
annual	1.1	14,102	221	99	52
summer				57	92
winter				153	13
Budapest (47°N)					
annual	1.3	11,500	118	43	46
summer				32	100
winter				51	-8
Sheffield (53°N)					
annual	0.5	10,420	58	19	56
West Berlin (52°N)					
annual	2.3	9,830	67	21	57
Vancouver (49°N)					
annual	0.6	5,360	112	19	57
summer				15	107
winter				23	6
Hong Kong (22°N)					
annual	3.9	3,730	34	4	~110
Singapore (1°N)					
annual	2.1	3,700	25	3	~110
Los Angeles (34°N)					
annual	7.0	2,000	331	21	108
Fairbanks (64°N)					
annual	0.03	810	740	19	18

Table 3-8

Surface Characteristics Used in Example Test Case

Season	Sector/ Land Use Type	Albedo[a]	Bowen Ratio[b]	Z_0 (application)[c]
Winter	Deciduous	0.50	1.50	0.50
Spring	Deciduous	0.12	0.70	1.00
Summer	Deciduous	0.12	0.30	1.30
Fall	Deciduous	0.12	1.00	0.80
Winter	Urban	0.35	1.50	1.00
Spring	Urban	0.14	1.00	1.00
Summer	Urban	0.16	2.00	1.00
Fall	Urban	0,18	2.00	1.00

[a] From Table 3-4
[b] From Table 3-5 (Average Conditions)
[c] From Table 3-6

Table 3-9

Subroutines Associated with Stage 3 Processing Options

ITEM	ACTION	Subroutine
WIND	NWSWXX	WS1NWS
	ONSITE	WS1OS
TEMP	NWSWXX	TT1NWS
	ONSITE	TT1OS
MHGT	NWSWXX	Z1NWS
	ONSITE	Z1OS
STAB	NWSWXX	PGTNWS
	ONSITE	OS1PGT
	SESITE	OSSEPG
	SASITE	OSSAPG
	WNDWXX	OS2PGT
	TTDIFF	OSSRPG
	USERIN	OSINPG

```
     METEOROLOGICAL PROCESSOR FOR REGULATORY MODELS [MPRM (dated 96030)]

                         30-JAN-96     10:27:33

            STAGE-3 PROCESSING OF MERGED METEOROLOGICAL DATA

                    ********************************
                    *** JOB TERMINATED NORMALLY  ***
                    ********************************


 1. FILENAMES AS DETERMINED DURING SETUP

    TEST324.RPT                                       OPENED   SUCCESSFULLY
    TEST324.ERR                                       OPENED   SUCCESSFULLY
    MERGE.223                                         OPENED   SUCCESSFULLY
    TEST324.OUT                                       OPENED   SUCCESSFULLY


 2. DISPERSION MODEL DEFINED DURING SETUP:   ISCSTWET


 3. PROCESSING OPTIONS SELECTED DURING SETUP
    PROCESS        SCHEME

    WIND           ONSITE
    TEMPERATURE    ONSITE
    MIXING HEIGHTS NWSWXX
    STABILITY      TTDIFF


 4. STABILITY METHODS USED

       NWSWXX     0
       ONSITE     0
       SESITE     0
       SASITE     0
       WNDWXX     0
       TTDIFF   719
       USERIN     0


 5. PROCESSING ASSUMPTIONS

    WIND SPEED/TURB. MEASUREMENT HEIGHT (M):   10.00
    STACK HEIGHT (M)                           10.00
    TEMPERATURE HEIGHT (M)                      2.00


 6. LOCATIONS SPECIFIED IN SETUP

     DATA      SITE     LONGITUDE   LATITUDE
    PATHWAY     ID      (DEGREES)   (DEGREES)

      UA       24157    117.53W      47.63N
      SF       24155    118.85W      45.67N
      OS       LAFAYE   122.60W      45.50N

    *****************************************
    * LONGITUDE AND LATITUDE FOR PROCESSING *
    *         122.60      45.50             *
    *****************************************
```

Figure 3-1a   Report file for Stage 3 processing (1 of 2)

METEOROLOGICAL PROCESSOR FOR REGULATORY MODELS [MPRM (dated 96030)]

30-JAN-96 10:27:33

STAGE-3 PROCESSING OF MERGED METEOROLOGICAL DATA

7. OUTPUT FILE NAMES.

ERROR REPORT FILE: TEST324.ERR
MET DATA FOR MODELING: TEST324.OUT
HEADER ON OUTPUT FILE: 24157 94 24155 94

8. SUMMARY OF DATA PROCESSING RESULTS

VARIABLE	# VALID	# MISSING	
STABILITY	719	1	
WIND SPEED	673	1	46 (Calms)
WIND DIRECTION	719	1	
RURAL MIXING HEIGHT	719	1	
URBAN MIXING HEIGHT	719	1	
TEMPERATURE	719	1	5.16 (Average)

9. DISTRIBUTION OF WIND SPEEDS

WS CLASS	1	2	3	4	5	6
# HOURS	235.	265.	138.	31.	4.	0.
AVERAGE	1.38	2.42	4.07	6.38	9.05	0.00

10. RURAL STABILITY CATEGORY RESULTS (# HOURS)

A	B	C	DD	DN	EF
0	20	41	213	205	240

11. SURFACE CHARACTERISTICS USED

Month	Sector	Albedo	Bowen	z0(meas)	z0(appl)	Min. L	Cg	Anth Heat
1	1	0.5000	1.5000	0.1500	0.5000	2.0000	0.1500	0.0000
2	1	0.5000	1.5000	0.1500	0.5000	2.0000	0.1500	0.0000
3	1	0.1200	0.7000	0.1500	1.0000	2.0000	0.1500	0.0000
4	1	0.1200	0.7000	0.1500	1.0000	2.0000	0.1500	0.0000
5	1	0.1200	0.7000	0.1500	1.0000	2.0000	0.1500	0.0000
6	1	0.1200	0.3000	0.1500	1.3000	2.0000	0.1500	0.0000
7	1	0.1200	0.3000	0.1500	1.3000	2.0000	0.1500	0.0000
8	1	0.1200	0.3000	0.1500	1.3000	2.0000	0.1500	0.0000
9	1	0.1200	1.0000	0.1500	0.8000	2.0000	0.1500	0.0000
10	1	0.1200	1.0000	0.1500	0.8000	2.0000	0.1500	0.0000
11	1	0.1200	1.0000	0.1500	0.8000	2.0000	0.1500	0.0000
12	1	0.5000	1.5000	0.1500	0.5000	2.0000	0.1500	0.0000
1	2	0.3500	1.5000	0.1500	1.0000	50.0000	0.2700	0.0000
2	2	0.3500	1.5000	0.1500	1.0000	50.0000	0.2700	0.0000
3	2	0.1400	1.0000	0.1500	1.0000	50.0000	0.2700	0.0000
4	2	0.1400	1.0000	0.1500	1.0000	50.0000	0.2700	0.0000
5	2	0.1400	1.0000	0.1500	1.0000	50.0000	0.2700	0.0000
6	2	0.1600	2.0000	0.1500	1.0000	50.0000	0.2700	0.0000
7	2	0.1600	2.0000	0.1500	1.0000	50.0000	0.2700	0.0000
8	2	0.1600	2.0000	0.1500	1.0000	50.0000	0.2700	0.0000
9	2	0.1800	2.0000	0.1500	1.0000	50.0000	0.2700	0.0000
10	2	0.1800	2.0000	0.1500	1.0000	50.0000	0.2700	0.0000
11	2	0.1800	2.0000	0.1500	1.0000	50.0000	0.2700	0.0000
12	2	0.3500	1.5000	0.1500	1.0000	50.0000	0.2700	0.0000

Figure 3-1b Report file for Stage 3 processing (2 of 2)

```
    30 JB I03 MPPROC: IOSTAT=     3047 REACHED END OF HEADERS
     8 JB I19 MPSTUP: FOUND "END OF FILE" ON DEVICE DEVIN  5
     0 OS W15 AUTCHK: MHGT NOT IN INPUT LIST: AUDIT DISABLED
     0 OS W15 AUTCHK: NRAD NOT IN INPUT LIST: AUDIT DISABLED
     0 OS W15 AUTCHK: SE   NOT IN INPUT LIST: AUDIT DISABLED
   365 JB W06 HTKEY : NO TT AT LVL01.  TMPHGT IS:   2.0
                                  .
                                  .
                                  .
   365 MP T75 OS1PGT: ISPD MISSING, HR 23 PGSTAB .EQ. 0
   365 MP T76  ROUGH:  NO WD FOR ZO, HOUR 23
   365 MP T75 OSSEPG: ZO MISSING FOR HOUR: 23
   365 MP T75 OSSEPG: ISPD MISSING, HR 23 PGSTAB .EQ. 0
   365 MP T76  ROUGH:  NO WD FOR ZO, HOUR 23
   365 MP T75 OSSAPG: ZO MISSING FOR HOUR: 23
   365 MP T75 OSSAPG: ISPD MISSING, HR 23 PGSTAB .EQ. 0
   365 MP T75 OS2NWS: ISPD MISSING, HR 23 PGSTAB .EQ. 0
   365 MP T75 SFSTAB: HOUR 23 NO PG CATEGORY POSSIBLE
   365 MP T75 OS1PGT: OSTSKY MISSING, HR 24 PGSTAB .EQ. 0
   365 MP T75 OSSEPG: SE & SW MISSING, HR 24 PGSTAB .EQ. 0
   365 MP I40 SFSTAB: HOUR 24 USED STAB. SCHEME SASITE
   365 MP W75 SFSTAB: 23 HOURS HAVE 0 FOR PG CATEGORY
```

Figure 3-2 Partial listing of the error/message file, for example with trace option enabled.

SECTION 2

PROCESSING - STAGES 1 AND 2

2.1 STAGE 1 PROCESSING - EXTRACTION AND QUALITY ASSESSMENT

Example input runstreams and report files have been packaged with the test cases for MPRM and are available, along with the executables for MPRM, for downloading from SCRAM. If you have not already done so, these files should downloaded and copied to a working directory; see the instructions on 'Getting Started' in Section 1.8.

Selected example test cases provide the basis for the instructions which follow. Additional information on all of the example test cases is provided in Appendix D. It is hoped that review of these materials will be an effective means of completing the learning curve for MPRM. In addition, the following additional material should be useful: Appendix A, which provides a listing of the keywords available to each pathway and Appendix B, which provides definitions and the input syntax for the keywords.

Note, in preparing to process data with MPRM, one needs to review the values used (in the raw input data file) to identify missing (null) data to ensure correspondence with the MPRM missing value indicators listed in Appendix C. If the values do not agree, the default missing value indicator(s) should be changed to correspond with the values used in the data file (see text on use of the CHK keyword in Sections 2.1.1, 2.1.2, and 2.1.3). Failing this, MPRM may interpret missing data as being out of range. There are no fixed standards for missing (null) value indicators for meteorological data; consequently, this check should be made for all data regardless of the pathway.

2.1.1 Extraction and QA of Upper Air Data

An example runstream illustrating the extraction and QA of upper air data is presented in Table 2-1. As necessary (e.g., to illustrate an option not employed in a test case) additional images have been added to the input runstreams. These additional images are identified by *italics*. In addition, keywords are highlighted in **bold** when they are first introduced. This is done to alert the reader that material related to a new keyword is being presented. The same keyword may appear multiple times later on in the text, but these later occurrences will normally not be highlighted unless new information pertaining to the keyword is presented.

The input images to the processor have a structure, which when understood, facilitates construction of customized runstreams. The three-character keywords are, for the most part, abbreviations of the actions that this input should invoke.

Consider the first three input images shown in Table 2-1.

2-character pathway

3-character keyword

JB STA

JB OUT DISK TEST121.RPT

JB ERR DISK TEST121.ERR

The first image **JB STA** indicates the start of the input images for the JB pathway. The **STA** keyword, although optional, helps to structure the input and therefore, is retained for purposes of instruction. The second image is also optional; the keyword **OUT** in this image defines the name for the general report file. By default, if the general report file is not defined, all print is routed to logical unit 6. On a mainframe computer, this is the default printer for batch processing; on a PC, the default for unit 6 is the screen. To ensure that the report file is retained it should always be defined following the **OUT** keyword. The third image contains the mandatory keyword **ERR** and provides the name of the error/message file. The contents of this file are described in Section 2.1.5.

The **JB RUN** image is optional and is used for checking syntax. When this image is present, the MPRM processor checks the entire runstream for syntax and then stops. This is a quick way to check the runstream for syntax errors. To actually process data, simply remove this image from the runstream. The fifth image contains the mandatory keyword **FIN** and signals the end of the input data for the JB pathway.

Instructions to MPRM for processing of upper air data begin with the **UA STA** input image. This is followed by images providing necessary information for accessing these data. The **UA IN1** image provides information related to rawinsonde data files; these files contain data for twice per day vertical profiles of pressure, temperature, humidity, wind speed, and wind direction. These data are contained on a magnetic tape identified by the logical name 'TAPE10'. The format field '5600VB' indicates that the data are written using the NWS TD-5600 format with a variable blocked structure. The 'ASCII' field identifies the character set, in this case, American Standard Code for Information Interchange. The '24157' field is the station identification number. Procedures for accessing tape files and assigning logical tape names, etc. are system dependent.

The **UA TOP** image applies to the profile data defined in the UA IN1 image. It instructs the processor to extract and process upper air data at or below 7000 meters. This is referred to as the clipping height; all data above 7000 meters are "clipped," i.e., disregarded. The default value for the clipping height is 5000 meters.

The **UA IN2** image provides necessary information for accessing twice per day estimated mixing height data. The 'USER' field indicates that the data are contained in a user disk file having the filename 24157-94.MIX. The character string following the file name, '(A5,3I2,1X,I5,13X,I5)' is the Fortran format statement which will be used by MPRM to read the mixing heights. The last item in the UA IN2 input, the '24157' field, is the station number for the NWS upper air site.

The **UA LOC** image provides the station identification number, the latitude and longitude (in decimal degrees), and the number of hours to be subtracted to convert the times given in the data file to Local Standard Time (LST). The latter adjustment depends on the location and the type of data being extracted. For an east coast location, the conversion to LST requires an adjustment of 5 hours (i.e., EST = GMT - 5); for a west coast location the adjustment is 8. The **LOC** keyword is also used on the SF and OS pathways.

The **UA EXT** image, defines the starting and ending times for the extraction. The sequence year, month, and day must be observed in specifying extraction dates. The year may be defined by all four digits or by the last two digits only. In the example, an extra day has been added to the beginning and end of the extraction to facilitate subsequent processing of the mixing heights. This is necessary because MPRM (Stage 3) uses an interpolation scheme to estimate hourly mixing heights based on the twice daily values for the preceding and following days. The **EXT** keyword is also used on the SF, OS, MR, and MP pathways.

The **UA IQA** and **UA OQA** images define the input and output files for the QA processing. The contents of these two files are identical in the current version of MPRM (see Appendix F, page F-16). The additional (redundant) file is included in MPRM to facilitate the possible incorporation of automatic substitution procedures at some point in the future. The additional file would then be used to store the modified data.

The **UA CHK** image provides a means for redefining (overriding) the default settings used during QA. The information following the **CHK** keyword provides the variable name, range check switch, missing value flag, and the upper and lower bounds for the QA. Variable names are unique four-character strings. Default settings for the variables associated with the UA-pathway are given in Table C-1 in Appendix C. The units for the upper and lower bounds must be the same as those employed within the processor and defined in Appendix C. An example input runstream image follows.

UA CHK UAPR 1 -9999 4000 10999

Upper bound of range

Lower bound of range

Missing value indicator

Range check switch

Name of variable

In the example given, UAPR is the variable name for the upper air atmospheric pressure. The upper and lower bounds for this variable are in tenths of millibars. Hence, the lower bound of 4000 translates to 400 mb; the upper bound translates to 1099.9 mb. The range check switch tells the processor how to perform the range check. A value of 1 excludes the upper and lower bounds while a value of 2 includes them. In the example, the range check switch is set to 1. Hence, a value of 400 mb would be considered out of bounds, and a warning message would be listed to the error/message file.

The CHK keyword is unique in that the information provided following the keyword is remembered by MPRM and is available to subsequent stages of processing. This information is written to header records associated with the quality assessment input and output files. The processor incorporates the range check information into the header record that is written to the OQA file. In subsequent quality assessment checks, MPRM will use the range check information provided in the header records. The Stage 1 QA is often an iterative process and, consequently, *the range checks can be overridden as necessary; this is especially important with on-site data where the default range checks may not always be applicable. For example, an initial QA pass of on-site data (using the default range checks) will often flag values which upon further investigation are determined to be valid for the particular site. In such cases, one or more follow-up QA passes using revised range checks may be necessary to clearly segregate valid and invalid data.*

The last image in Table 2-1, the **JB END** image, is an alternate means for identifying the end of the input runstream. The processor assumes that the end of the input data occurs whenever it encounters an end-of-file (EOF) or the JB END input image.

2.1.2 Extraction and QA of Surface Data

An example runstream illustrating the extraction and QA of NWS surface and precipitation data is presented in Table 2-2. New keywords illustrated in this example and discussed in the following include: **IN3**, **AUD**, and **TRA**.

The **SF IN2** image in this example provides necessary information for extracting the surface data: the file name (24155-94.DAT), the file format (CD144FB), and the station identifier (24155). The character string for the file format 'CD144FB' indicates that this is an NCDC CD-144, fixed block (FB) data file. Other data formats recognized by the surface pathway are SCRAMFB and SAMSON. These formats are described in Appendix F.

The **SF IN3** image provides necessary information for extracting the precipitation data: the file name (24155-94.PPP), the file format (TD3240FB), and the station identifier (992415). The station identifier in the IN3 image is a six-digit number and should not be confused with the WBAN number provided in the IN2 input image. The station identifier is recorded in columns 4-9 in each TD-3240 record and includes a two-digit state code ('99' is a dummy) and a four-digit number assigned by NCDC ('2415' is also a dummy).

The **SF AUD** image adds the variable for present weather (PWTH) to the list of default variables appearing in the audit report. Present weather might be useful in a dispersion analysis if one anticipated that a pollutant might be "washed out" of the atmosphere during a precipitation event, like a rain shower, and therefore it would no longer be available for transport further downwind. Such information would be relevant in attempting to compare values of gaseous concentrations observed versus concentration values estimated by a dispersion model which makes no provision for pollutant washout.

The default audit variables for the SF-pathway are: sea-level pressure, station pressure, ceiling height, sky cover, horizontal visibility, dry bulb temperature, wind direction, and wind speed. *The optional AUD input image need only be included when audits are desired for one or more non-default variables.* Several variables can appear on one AUD input image, so long as the image does not exceed 80 characters. The AUD input image can be repeated as often as necessary. The AUD image differs from the CHK image in that it is not remembered by the MPRM processor; i.e., the AUD image must be repeated each time QA is performed.

The **SF TRA** image turns the trace option on for the variables indicated: present weather (PWTH), pressure (PRES), ceiling height (CLTH), total and opaque sky cover (TSKC), temperature (TMPT), wind direction (WD16) and wind speed (WIND). The trace option writes a record to the error/message file indicating each occurrence of a missing value.

The **TRA** keyword should be used with caution especially if one is not familiar with the data being processed. SCRAM surface data, for example, do not include present weather or pressure. Consequently, if the example SF TRA image were used with a SCRAM surface file, it would result in at least two missing data messages (records) for each hour.

2.1.3 Extraction and QA of On-site Data

Site specific, user collected meteorological data do not have a standard format; in fact, the variety of measurements possible preclude development of such a standard. This being the case, MPRM has been designed such that the formats for these files can be included in the input runstream to MPRM. This provides flexibility within MPRM for processing generic format meteorological data files. The following rules apply:

- Observations (records) must be ordered sequentially
- There must be no missing records
- Each record must contain data for the same variables and in the same order
- The data must be in a form such that it can be read using a Fortran Format Statement

An example runstream illustrating the extraction and assessment of on-site meteorological data is presented in Table 2-3. New keywords illustrated in this example and discussed in the following include: **AVG**, **HGT**, **DT1**, **MAP**, and **FMT**.

The **OS AVG** image defines the maximum number of data records expected for each hour; The default is 1. In the example, the value '4' following the **AVG** keyword indicates that up to four data records may be provided for each hour. This would be the case for a data file created by a data logger using 15-minute averaging. MPRM will read on-site data records until a new hour is encountered. Hourly averages are computed if at least 50 percent of the sub-hourly data are present, otherwise the hour is flagged as missing. The AVG input image is only needed for the initial processing of on-site data. Thereafter, only hourly averaged data are available for processing. *Users should note that MPRM assumes that the label assigned to an hourly observation or hourly average is the integer value for the hour beginning; e.g., an hourly average for the period 01:00 to 02:00 should be assigned a time label of 01.*

The **OS HGT** image provides the measurement heights for multi-level variables, if any. This information would be necessary if the on-site data base included measurements from a meteorological tower instrumented at several levels. The image provided in the example indicates that measurements are available for 2 levels, 20 m and 100 m.

The **OS DT1** image provides the measurement heights for vertical temperature difference (Delta-T) data, if any. In this example, Delta-T would have been measured between 2 and 20 m. MPRM will handle up to three temperature difference measurements (DT1, DT2, and DT3). The measurement heights for each are entered as per the example for DT1. *In MPRM the measurement heights defining the vertical temperature difference are independent of the measurement heights for the multilevel variables.*

The **OS MAP** image lists the names of the on-site variables to be extracted and may be repeated depending on the structure of the data file. MPRM allows considerable flexibility in the structure of on-site data files; however, the following restrictions on file organization apply:

- The first two fields in the first record for each time period should contain the date and time (the order is not important). The time must, at the very least, define the hour to be associated with the observation. All date and time data must be capable of being read using INTEGER format.

- The meteorological data should follow the date and time; these data may be continued on additional records, as necessary up to a maximum of 20 records per time period. No more than 40 values can be given in any one record.

The **OS MAP DAT01** image in the example indicates that the first record contains data for the following variables: year (OSYR), month (OSMO), day (OSDY), hour (OSHR), wind speed (WS01), temperature (TT01), vertical temperature difference (DT01), wind direction (WD01), sigma theta (SA01), and insolation (INSO). The **OS MAP DAT02** image indicates that the second record contains data for WD02, WS02, SA02, and TT02. The complete list of variables available for the OS pathway is given in Table C-3 in Appendix C.

The **OS FMT** images provide the Fortran formats to be employed in reading each record. The **OS FMT DAT01** image shown in the example uses a '4X, 4I2.2' format to read the first four fields: year, month, day, and hour. The formats given in the FMT image are used by the processor in listing the data values to the file specified in the OQA image. By using 4I2.2 rather than 4I2 in our format specification, the date/time group, '94110101' in the first record would be written to the OQA file as '94110101'. Using 4I2 in the format specification, the first record would be written as '9411 1 1'; i.e., the leading zeros are lost with the 4I2 format. It is easier to read with the leading zeros; therefore, use of I2.2 style format is recommended in specifying the format for date and time in the FMT image.

Not all variables appearing in the input data file have to be mapped. Only those variables the user believes will be useful in the final application are required, whether it be dispersion modeling or other analyses. With proper usage of the X or T format specifier, variables can be skipped; with careful usage of the / format specifier, entire records can be skipped. The format statements defined by the FMT input images are used in all processing involving reading or writing of the on-site data from data files. Hence, if X, T or / format specifiers have been employed, the information skipped in the original raw data file will appear as blanks in subsequent files.

> *The format statements defined by the FMT input images are used in all processing involving reading or writing of the on-site data from data files. If in the course of quality assessment it is found necessary to edit the on-site data file, be sure not to alter the data format, or read errors will occur in subsequent attempts to process the data.*

The **OS CHK** images redefine the missing value flag and/or the default upper and lower bounds for the QA of the indicated variables: insolation (INSO), vertical temperature difference (DT01), and sigma theta (SA).

The **OS CHK DT01** image resets the default upper and lower bounds for the QA of vertical temperature difference from -200 (lower) and 500 (upper) to -10 (lower) and 5 (upper). *Note, the units for the upper and lower bounds are (°C). The magnitude of the vertical temperature difference depends, among other things, on the elevation and depth of the layer being monitored. Consequently, the QA of vertical temperature difference data will almost always require a change in the default upper and lower bounds; this may involve some experimentation. Note, the QA of DT01 involves comparisons of temperature differences; this is different than the QA procedures for upper air data which involves comparisons of lapse rates.*

The **OS AUD** image adds the variables for insolation (INSO) and vertical temperature difference (DT01) to the list of default variables appearing in the audit report. *The default variables for the OS pathway are: mixing height, wind speed, wind direction,* σ_A*,* σ_E*, sea level pressure, station pressure, ceiling height, and sky cover. The optional AUD input image need only be included when audits are desired for one or more non-default variables.*

2.1.4 Contents of the General Report File

The general report lists the input and output files, provides a summary of the kinds and frequency of messages, and a table summarizing the results of the quality assessment of the data. The general report files for Stage 1 processing for the three pathways UA, SF, and OS will all have similar information. An example from the Stage 1 extraction and QA for the SF pathway is shown in Figure 2-1.

The first page of the general report provides information on the status of the processing environment prior to actual processing. The first item is the MPRM heading; this includes the MPRM version date and the date and time of the processing. This heading is standard and appears at the top of all output pages. Following the heading are the names of files to be used and the status of the pathway data files (OPEN or NOT OPEN). Other information provided includes: extraction dates, site identifier, and the latitude and longitude.

The remainder of the report provides: the MPRM message summary table; warning messages, if any; error messages, if any; and a summary of the audit results. The message summary table, in this example, indicates that 11 informational messages were generated (7 on the JB pathway and 4 on the SF pathway). There were no warning or error messages.

The audit for the surface data indicates that 720 observations for 11 variables were extracted. All 720 observations (100 percent) were accepted as valid for 5 of the variables. Audit results for the other surface variables indicate that one or more records were found with missing data; the number of 'bad' records (hours) ranges from 1 record (hour) for total sky cover (TS) to 10 records (hours) for ceiling height (CLHT). The total number of bad records is 26; this is a worst case since some records may have multiple counts (more than one missing value). Bad records are traced in the error/message file providing the variable is specified following the TRA keyword in the input runstream.

There are two 'double duty' SF variables included in the audit report, TSKC and PWTH. The four-character variable TSKC contains information on total and opaque sky cover. During processing, MPRM splits this double duty variable into its two component parts, TS (total sky cover) and KS (opaque sky cover). The two parts are listed on separate lines in the audit report. The variable PWTH is another example where two fields of information are stored together. PWTH contains information on prevailing (PW) and secondary weather (TH) occurring during the observation. All 'double duty' variables are two integer variables which have been combined to form a single integer variable (see Table C-2 for a list of these variables). These combined variables are separated prior to QA and any subsequent processing.

The footnotes to the audit report for the surface data indicate the number of calms (30) and provide results for audits involving comparisons of two variables. These comparisons check for invalid combinations of two variables; e.g., the dew point temperature should never exceed the dry bulb temperature. The following results are noted:

Zero wind speed with non-zero wind direction	0
Dew point greater than dry bulb temperature	0
Precipitation and weather mismatch	6

A summary of the Stage 1 audit results for the UA, SF, and OS pathways is presented in Figure 2-2. The audit provides information on the quality of the data as extracted - mixing heights on the UA pathway, surface data on the SF pathway, and site scalers and site vectors on the OS pathway. Information is provided for all default variables and any variables specified in an input runstream following the AUD keyword. Missing value flags and the upper and lower bounds used for checking the data are also indicated for each of the variables. These will normally be default values unless overridden in an input runstream following the CHK keyword.

On the UA pathway, only the twice-daily mixing height values (NCDC TD-9689 data) are audited by default. However, other audit variables can always be added with the AUD keyword (the syntax of the AUD input image is given in Appendix B). The audit report in this example shows that 32 values of morning (UAM1) and afternoon (UAM2) mixing heights were extracted and that all were accepted.

The audit information for the SF pathway (see violation summary for surface data in Figure 2-2) is the same as that given in Figure 2-1 and discussed above.

The audit information for the OS pathway indicates that there are at least one (i.e., the four missing values occurred in the same hour/record) and possibly as many as four 'bad' records (i.e., the four missing values occurred in four different hours/records. More than likely, the four missing-value flags all occurred in the same hour (record). However, this would have to be verified by examining the error/message file. In addition to the missing records, the audit also indicates that the SA site vector (i.e., Sigma Theta) exceeded the upper bound (50 degrees) on 15 occasions.

2.1.5 Contents of the Error/Message File

An extract from the error/message file from the Stage 1 extraction of the surface data is provided in Figure 2-3. The first ten records provide information about the job and what data were extracted. Seven of these messages are associated with the JB pathway and three are associated with the SF pathway. The latter have to do with accessing the data files for the surface observations and reporting how many observations were processed. The fourth informational message associated with the SF pathway is an 'end-of-file' message and appears at the bottom of the file.

The information related to 'bad records' begins with the 11th record as follows:

30502 SF SFQASM: CLHT MISSING ON 94/11/01/02

This record indicates that ceiling height (CLHT) was missing for 02:00 on November 1, 1994. Other records are translated similarly. With the exception of a missing value reported for surface pressure on 94/11/02/02, all of the bad records occur on 94/11/01. This is because the first 12 records in the surface file were deliberately altered for the purpose of testing the QA procedures for missing data. Normally, one would expect that bad records would be more randomly distributed throughout the data file. In any case, the bad records should be corrected before proceeding to Stage 2. As this is an extract from a larger file, we do not see all of the records that have been flagged in the QA. The full file, reproduced in Appendix D (Figure D-16) contains the following:

Type of Message	Number
Informational JB	7
Informational SF	4
Missing Data	26
Calms	30
Precipitation/Wx Mismatch	6
Total	73

2.1.6 Summary of Stage 1 Output

Stage 1 of MPRM produces three types of output files: a general report file, an error/message file, and data files.

The general report summarizes the processing results and is typically only several pages long. The contents of the general report file are discussed in Section 2.1.4.

The error/message file contains all the messages generated during processing and can be quite large depending on the data file. Appendix E provides a listing of the various messages associated with all stages of MPRM processing; there are nearly 100 different messages possible. As the error/message file may be rather long, it may not always be practical or advisable to try to print it. The user should view the contents using a general purpose text editor. A discussion of the structure and content of the error messages written to the error/message file is provided in Section 6. Also within Section 6 is a discussion of how the general report is altered when errors are encountered.

Two data files are created during the Stage 1 extraction and QA for the UA and SF pathways. These are the raw extracted data file, defined by the IQA keyword, and the quality assessed data file, defined by the OQA keyword. The contents of these two files in the current version of MPRM is identical (see Appendix F, page F-16 for discription and format of the IQA/OQA files for the UA pathway and pages F-17 and F-18 for the description and format of the IQA/OQA files for the SF pathway). The Stage 1 QA for the OS pathway creates only one data file containing the quality assessed data and defined by the OS OQA input image.

2.2 STAGE 2 PROCESSING

The goal of the Stage 2 processing is to combine (merge) the quality assessed data from two or more pathways for subsequent use in Stage 3 processing. The output from Stage 2 is stored in an unformatted (binary) data file.

An example runstream for a Stage 2 merge of UA, SF, and OS data is presented in Table 2-4. The **MR OUT** image in this example provides the file name for the merge output. Other keywords in this example have been discussed in preceding examples.

The **MR EXT** image is optional. Specifying start and stop dates to be associated with Stage 2 processing, this input provides a means for selecting the data to be included in the merged data file. This might be useful if one wanted to create a merged data file for a specific few days or months. If the MR EXT image is omitted, MPRM searches the OQA files on each pathway for the earliest date. This date becomes the first day of merged data. The last day of merged data acceptable is then defined as the first day plus 367. In other words, omission of the MR EXT input allows up to 368 days of data to be merged, starting from the earliest date encountered on all the input files.

Table 2-1

Runstream for the Extraction and Quality Assessment of Upper Air Data.

JB **STA**	Start JB input
JB **OUT** DISK TEST121.RPT	Defines name for general report file
JB **ERR** DISK TEST121.ERR	Defines name for error/message file
*JB **RUN***	Check for syntax only
JB **FIN**	Finish JB input
UA STA	Start UA input
*UA **IN1** TAPE TAPE10 5600VB ASCII 24157*	Provides information for extracting upper air data
*UA **TOP** 7000*	Define clipping height
UA **IN2** USER 24157-94.MIX (A5,3I2,2X,I4,14X,I4) 24157	Provides information for extracting mixing heights
UA **LOC** 24157 117.53W 47.63N +8	Defines location of mixing height data
UA **EXT** 94 10 31 94 12 01	Defines time period for extraction of mixing heights
UA **IQA** DISK IQAUA.121	Defines name for QA input file (extracted data file)
*UA **CHK** UAPR 1 -9999 4000 10999*	Redefine default bounds for QA of pressure (UAPR)
UA **OQA** DISK OQAUA.121	Defines name for QA output file
UA **FIN**	Finish UA input
*JB **END***	End of runstream

Table 2-2

Runstream for the Extraction and Quality Assessment of NWS Surface Data

JB STA	Start JB input
JB OUT DISK TEST122.RPT	Defines name for general report file
JB ERR DISK TEST122.ERR	Defines name for error/message file
JB FIN	Finish JB input
SF STA	Start SF input
SF IN2 DISK 24155-94.DAT CD144FB 24155	Provides information for extracting NWS surface data
SF **IN3** DISK 24155-94.PPP TD3240FB 992415	Provides information for extracting precipitation data
SF LOC 24157 118.85W 45.67N 0	Defines location of NWS surface data
SF EXT 94 11 01 94 11 30	Defines time period for extraction of surface data
SF IQA DISK IQASF.122	Defines name for QA input file (extracted data file)
SF OQA DISK OQASF.122	Defines name for QA output file
SF **AUD** PWTH	Adds present weather (PWTH) to the audit report
SF **TRA** PWTH PRES CLHT TSKC TMPT WD16 WIND	Adds specified variables to trace report
SF FIN	Finish SF input

Table 2-3

Runstream for the Extraction and Quality Assessment of On-site Data

JB STA	Start JB input
JB OUT DISK TEST123.RPT	Defines name for general report file
JB ERR DISK TEST123.ERR	Defines name for error/message file
JB FIN	Finish JB input
OS STA	Start OS input
OS IQA DISK LAF-OS.MET	Defines name of on-site data file
OS LOC LAFAYE 122.60W 45.50N 0	Defines location of in-site data
OS EXT 94 11 01 94 11 30	Defines time period for extraction of on-site data
OS **AVG** 4	Defines maximum number of values per hour
OS **HGT** 2 20 100	Defines heights for multi-level variables
OS **DT1** 2 20	Defines heights for temperature difference
OS **MAP** DAT01 OSYR OSMO OSDY OSHR WS01 TT01 DT01 WD01 SA01 INSO	Defines list of on-site variables
OS **MAP** DAT02 WD02 WS02 SA02 TT02	Defines list of on-site variables
OS **FMT** DAT01 (4X, 4I2.2, F9.1, 9X, 5F9.1)	Defines format for on-site data
OS **FMT** DAT02 (4F6.2)	Defines format for on-site data
OS CHK INSO 2 9999 0 700	Redefines default upper and lower bounds for QA of insolation
OS CHK DT01 1 -999 -10 5	Redefines default bounds for QA of Delta-T
OS CHK SA 1 99 0 50	Redefines default bounds for QA of Sigma-Theta
OS AUD INSO DT01	Adds insolation and Delta-T to the QA audit report
OS OQA DISK OQAOS.123	Defines name for QA output file
OS FIN	Finish OS input

```
        METEOROLOGICAL PROCESSOR FOR REGULATORY MODELS [MPRM (dated 96030)]

                            30-JAN-96     10:19:28

               STAGE 1 EXTRACTION AND QA OF METEOROLOGICAL DATA

           ********************************************************
           ***             JOB TERMINATED NORMALLY              ***
           ********************************************************

                 STATUS REPORT PRIOR TO BEGINNING PROCESSOR RUN

 1.  REPORT FILE NAMES

      ERROR MESSAGES: TEST122.ERR
      SUMMARY OF RUN: TEST122.RPT

 2.  UPPER AIR DATA

     THE PROCESS(ES) MPRM ANTICIPATES TO PERFORM ARE:

           NONE - NO DATA TO BE PROCESSED ON THIS PATH

 3.  NWS SURFACE DATA

      SITE ID    LATITUDE(DEG.)   LONGITUDE(DEG.)
        24155       45.67N           118.85W

     THE PROCESS(ES) MPRM ANTICIPATES TO PERFORM ARE:

           EXTRACT AND QUALITY ASSESSMENT

          EXTRACT INPUT -    OPEN: 24155-94.DAT
          EXTRACT OUTPUT-    OPEN: IQASF.122
          QA OUTPUT     -    OPEN: OQASF.122

          THE EXTRACT DATES ARE:    STARTING:  1-NOV-94
                                      ENDING: 30-NOV-94

 4.  ON-SITE DATA

     THE PROCESS(ES) MPRM ANTICIPATES TO PERFORM ARE:

           NONE - NO DATA TO BE PROCESSED ON THIS PATH

                      **** MPRM MESSAGE SUMMARY TABLE ****

        0- 9   10-19   20-29   30-39   40-49   50-59   60-69   70-79   TOTAL
      ----------------------------------------------------------------------

    JB
      E    0       0       0       0       0       0       0       0       0
      W    0       0       0       0       0       0       0       0       0
      I    0       7       0       0       0       0       0       0       7

    SF
      E    0       0       0       0       0       0       0       0       0
      W    0       0       0       0       0       0       0       0       0
      I    0       0       0       0       4       0       0       0       4
      Q    0       0       0       0       0       0       0       0       0
      ----------------------------------------------------------------------
           0       7       0       0       4       0       0       0      11
```

Figure 2-1a   Report file for extraction and QA of surface data (1 of 2).

```
        METEOROLOGICAL PROCESSOR FOR REGULATORY MODELS [MPRM (dated 96030)]

                            30-JAN-96     10:19:28

               STAGE 1 EXTRACTION AND QA OF METEOROLOGICAL DATA


       ****   WARNING MESSAGES ****

              ---  NONE  ---


       ****    ERROR MESSAGES  ****

              ---  NONE  ---


            *******************************************************
            ***             JOB TERMINATED NORMALLY             ***
            *******************************************************


                       **** SUMMARY OF THE QA AUDIT ****


SURFACE DATA         |------VIOLATION SUMMARY------|   |-----TEST VALUES-----|
              TOTAL     #     LOWER  UPPER     %      MISSING   LOWER   UPPER
              # OBS  MISSING  BOUND  BOUND  ACCEPTED    FLAG    BOUND   BOUND
      SLVP     720       0      0      0     100.00    -9999.0, 9000.0,10999.0
      PRES     720       4      0      0      99.44    -9999.0, 9000.0,10999.0
      CLHT     720      10      0      0      98.61    -9999.0,    0.0,  300.0
      TS       720       2      0      0      99.72       99.0,    0.0,   10.0
        KC     720       1      0      0      99.86       99.0,    0.0,   10.0
      PW       720       0      0      0     100.00       99.0,    0.0,   92.0
        TH     720       0      0      0     100.00       99.0,    0.0,   92.0
      HZVS     720       0      0      0     100.00    -9999.0,    0.0, 1640.0
      TMPD     720       0      0      0     100.00    -9999.0, -300.0,  350.0
      WD16     720       5      0      0      99.31    -9999.0,    0.0,   36.0
      WIND     720       4      0      0      99.44    -9999.0,    0.0,  500.0

NOTE: TEST VALUES MATCH INTERNAL SCALING APPLIED TO VARIABLES
      (SEE APPENDIX C OF THE USER'S GUIDE)


    THE FOLLOWING CHECKS WERE ALSO PERFORMED FOR THE SURFACE QA
      OF   720 REPORTS, THERE WERE
            30 CALM WIND CONDITIONS (WS=0, WD=0)
             0 ZERO WIND SPEEDS WITH NONZERO WIND DIRECTIONS
             0 DEW-POINT GREATER THAN DRY BULB TEMPERATURES
             6 PRECIPITATION & WEATHER MISMATCH
    THE TIMES OF THESE OCCURRENCES CAN BE FOUND IN THE MESSAGE FILE
     WITH QUALIFIERS CLM, ZNZ, DTT & PPT (RESP.)



    THIS CONCLUDES THE AUDIT TRAIL
```

Figure 2-1b   Report file for extraction and QA of surface data (2 of 2).

```
              METEOROLOGICAL PROCESSOR FOR REGULATORY MODELS [MPRM (dated 96030)]

                                30-JAN-96     10:19:19

                     STAGE 1 EXTRACTION AND QA OF METEOROLOGICAL DATA


                            **** SUMMARY OF THE QA AUDIT ****
Pathway

 UA       MIXING HTS      |------VIOLATION SUMMARY------|  |-----TEST VALUES-----|
                    TOTAL     #    LOWER  UPPER     %      MISSING   LOWER   UPPER
                    # OBS  MISSING BOUND  BOUND  ACCEPTED    FLAG     BOUND   BOUND
              UAM1    32       0      0      0    100.00    -9999.0,   50.0, 2500.0
              UAM2    32       0      0      0    100.00    -9999.0,   50.0, 4500.0


 SF      SURFACE DATA     |------VIOLATION SUMMARY------|  |-----TEST VALUES-----|
                    TOTAL     #    LOWER  UPPER     %      MISSING   LOWER   UPPER
                    # OBS  MISSING BOUND  BOUND  ACCEPTED    FLAG     BOUND   BOUND
              SLVP   720       0      0      0    100.00   -9999.0, 9000.0,10999.0
              PRES   720       4      0      0     99.44   -9999.0, 9000.0,10999.0
              CLHT   720      10      0      0     98.61   -9999.0,    0.0,  300.0
              TS     720       2      0      0     99.72      99.0,    0.0,   10.0
                KC   720       1      0      0     99.86      99.0,    0.0,   10.0
              PW     720       0      0      0    100.00      99.0,    0.0,   92.0
                TH   720       0      0      0    100.00      99.0,    0.0,   92.0
              HZVS   720       0      0      0    100.00   -9999.0,    0.0, 1640.0
              TMPD   720       0      0      0    100.00   -9999.0, -300.0,  350.0
              WD16   720       5      0      0     99.31   -9999.0,    0.0,   36.0
              WIND   720       4      0      0     99.44   -9999.0,    0.0,  500.0


 OS      SITE SCALARS     |------VIOLATION SUMMARY------|  |-----TEST VALUES-----|
                    TOTAL     #    LOWER  UPPER     %      MISSING   LOWER   UPPER
                    # OBS  MISSING BOUND  BOUND  ACCEPTED    FLAG     BOUND   BOUND
              INSO   720       0      0      0    100.00     9999.0,    0.0,  700.0
              DT01   720       0      8     20     96.11     -999.0,  -10.0,    5.0


 OS      SITE VECTORS     |------VIOLATION SUMMARY------|  |-----TEST VALUES-----|
                    TOTAL     #    LOWER  UPPER     %      MISSING   LOWER   UPPER
                    # OBS  MISSING BOUND  BOUND  ACCEPTED    FLAG     BOUND   BOUND
                                          20.00 M
              SA     720       1      0     15     97.78       99.0,    0.0,   50.0
              TT     720       1      0      0     99.86       99.0,  -30.0,   35.0
              WD     720       1      0      0     99.86      999.0,    0.0,  360.0
              WS     720       1      0      0     99.86      999.0,    0.0,   50.0


         THE FOLLOWING CHECKS WERE ALSO PERFORMED FOR THE SURFACE QA
              OF   720 REPORTS, THERE WERE
                   30 CALM WIND CONDITIONS (WS=0, WD=0)
                    0 ZERO WIND SPEEDS WITH NONZERO WIND DIRECTIONS
                    0 DEW-POINT GREATER THAN DRY BULB TEMPERATURES
                    6 PRECIPITATION & WEATHER MISMATCH
             THE TIMES OF THESE OCCURRENCES CAN BE FOUND IN THE MESSAGE FILE
              WITH QUALIFIERS CLM, ZNZ, DTT & PPT (RESP.)

                         THIS CONCLUDES THE AUDIT TRAIL
```

Figure 2-2   Summary of Stage 1 audit results for UA, SF, and OS pathways.

```
  15 JB I19  SETUP: FOUND "END OF FILE" ON DEVICE DEVIN  5

   0 JB I10   TEST: SUMMARY: NO UA-EXT CARD, NULL EXTRACT
   0 JB I11   TEST: SUMMARY: NO UA-IQA CARD, NULL QA
   0 JB I12   TEST: SUMMARY: NO UA-OQA CARD, NULL MERGE
   0 JB I10   TEST: SUMMARY: NO OS-EXT CARD, NULL EXTRACT
   0 JB I11   TEST: SUMMARY: NO OS-IQA CARD, NULL QA
   0 JB I12   TEST: SUMMARY: NO OS-OQA CARD, NULL MERGE

   0 SF I40  SFEXT: *** HLY SFC OBS & PRECIP EXTRACTION ***
 720 SF I49 RD144D: END-OF DATA WINDOW AFTER RECORD  721
   0 SF I49  SFEXT:  720 HLY WX &  720 PRECIP OBS EXTRACTED

30502 SF     SFQASM: CLHT MISSING ON  94/11/01/02
30502 SF PPT SFQASM: WEATHER WITHOUT PRECIP ON 94/11/01/02
30503 SF     SFQASM: CLHT MISSING ON  94/11/01/03
30504 SF     SFQASM: CLHT MISSING ON  94/11/01/04
30504 SF PPT SFQASM: PRECIP WITHOUT WEATHER ON 94/11/01/04
30505 SF     SFQASM: CLHT MISSING ON  94/11/01/05
30505 SF PPT SFQASM: PRECIP WITHOUT WEATHER ON 94/11/01/05
30506 SF     SFQASM: CLHT MISSING ON  94/11/01/06
30507 SF     SFQASM: CLHT MISSING ON  94/11/01/07
30507 SF     SFQASM: WD16 MISSING ON  94/11/01/07
30508 SF     SFQASM: CLHT MISSING ON  94/11/01/08
30508 SF     SFQASM: WD16 MISSING ON  94/11/01/08
30508 SF     SFQASM: WIND MISSING ON  94/11/01/08
30508 SF PPT SFQASM: PRECIP WITHOUT WEATHER ON 94/11/01/08
30509 SF     SFQASM: PRES MISSING ON  94/11/01/09
30509 SF     SFQASM: CLHT MISSING ON  94/11/01/09
30509 SF     SFQASM: WD16 MISSING ON  94/11/01/09
30509 SF     SFQASM: WIND MISSING ON  94/11/01/09
30509 SF PPT SFQASM: PRECIP WITHOUT WEATHER ON 94/11/01/09
30510 SF     SFQASM: PRES MISSING ON  94/11/01/10
30510 SF     SFQASM: CLHT MISSING ON  94/11/01/10
30510 SF     SFQASM: TSKC MISSING ON  94/11/01/10
30510 SF     SFQASM: WD16 MISSING ON  94/11/01/10
30510 SF     SFQASM: WIND MISSING ON  94/11/01/10
30510 SF PPT SFQASM: PRECIP WITHOUT WEATHER ON 94/11/01/10
30511 SF     SFQASM: PRES MISSING ON  94/11/01/11
30511 SF     SFQASM: CLHT MISSING ON  94/11/01/11
30511 SF     SFQASM: TSKC MISSING ON  94/11/01/11
30511 SF     SFQASM: TSKC MISSING ON  94/11/01/11
30511 SF     SFQASM: WD16 MISSING ON  94/11/01/11
30511 SF     SFQASM: WIND MISSING ON  94/11/01/11
30602 SF     SFQASM: PRES MISSING ON  94/11/02/02
30905 SF CLM SFQASM: CALM WINDS ON 94/11/05/05
30906 SF CLM SFQASM: CALM WINDS ON 94/11/05/06
30907 SF CLM SFQASM: CALM WINDS ON 94/11/05/07
                           .
                           .
                           .
  721 SF I49 SFQASM: END OF FILE AFTER OBS # 720
```

Figure 2-3 Extract from the Stage 1 error/message file for the SF pathway.

Table 2-4

Runstream for Merging of NWS Mixing Height and Surface Data with On-site Data

JB STA	Start JB input
JB OUT DISK TEST223.RPT	Defines name for general report file
JB ERR DISK TEST223.ERR	Defines name for error/message file
JB FIN	Finish JB input
UA STA	Start UA input
UA OQA DISK OQAUA.121	Provides name of upper air output file to merge
UA FIN	Finish UA input
SF STA	Start SF input
SF OQA DISK OQASF.122	Provides name of surface output file to merge
SF FIN	Finish SF input
OS STA	Start OS input
OS OQA DISK OQAOS.123	Provide name of on-site output file to merge
OS FIN	Finish OS input
MR STA	Start MR input
MR EXT 94 11 01 94 11 30	Define time period of data to merge
MR OUT DISK MERGE.223	Define name of merge output file
MR FIN	Finish MR input

An extract from the Stage 2 (merge) report file is presented in Figure 2-4. The report shows that upper air, surface, and on-site data for a one month (30 day) period were merged. The data include 24 records per day of surface and on-site data, and 6 records per day of mixing heights. The latter is necessary because in Stage 3 hourly mixing heights will be interpolated based on twice daily mixing heights for the preceding and following days.

```
      METEOROLOGICAL PROCESSOR FOR REGULATORY MODELS [MPRM (dated 96030)]

                        30-JAN-96     10:24:56

                  STAGE 2  MERGE METEOROLOGICAL DATA


                  ***** DAILY OUTPUT STATISTICS *****

             MO/DA 11/ 1 11/ 2 11/ 3 11/ 4 11/ 5 11/ 6 11/ 7 11/ 8 11/ 9 11/10
NWS  UPPER AIR  SDGS   0     0     0     0     0     0     0     0     0     0
NCDC MIXING  HEIGHTS   6     6     6     6     6     6     6     6     6     6
NWS SFC OBSERVATIONS  24    24    24    24    24    24    24    24    24    24
ON-SITE OBSERVATIONS  24    24    24    24    24    24    24    24    24    24

             MO/DA 11/11 11/12 11/13 11/14 11/15 11/16 11/17 11/18 11/19 11/20
NWS  UPPER AIR  SDGS   0     0     0     0     0     0     0     0     0     0
NCDC MIXING  HEIGHTS   6     6     6     6     6     6     6     6     6     6
NWS SFC OBSERVATIONS  24    24    24    24    24    24    24    24    24    24
ON-SITE OBSERVATIONS  24    24    24    24    24    24    24    24    24    24

             MO/DA 11/21 11/22 11/23 11/24 11/25 11/26 11/27 11/28 11/29 11/30
NWS  UPPER AIR  SDGS   0     0     0     0     0     0     0     0     0     0
NCDC MIXING  HEIGHTS   6     6     6     6     6     6     6     6     6     6
NWS SFC OBSERVATIONS  24    24    24    24    24    24    24    24    24    24
ON-SITE OBSERVATIONS  24    24    24    24    24    24    24    24    24    24


                              UPPER AIR OBS. READ:   32
                              SURFACE OBS. READ:    720
                              ON-SITE OBS. READ:    720

                  ***** MERGE PROCESS COMPLETED *****
```

Figure 2-4 Extract from the Stage 2 (MERGE) report file.

SECTION 7

REFERENCES

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APPENDIX A

SUMMARY OF INPUT KEYWORDS

This appendix provides summary information for the keywords used in the MPRM processor. The summaries are functionally divided into six areas called pathways. Separate tables are presented summarizing the keywords applicable to each pathway. The pathways are identified by two-letter acronyms as follows:

- JB processes that affect or pertain to the entire job (see Table A-1 for a summary of the keywords associated with this pathway)
- UA processes related to NWS upper air data and NCDC mixing height estimates (see Table A-2 for a summary of the keywords associated with this pathway)
- SF processes related to NWS hourly surface data (see Table A-3 for a summary of the keywords associated with this pathway)
- OS processes related to site specific (on-site) meteorological data (see Table A-4 for a summary of the keywords associated with this pathway)
- MR processes related to the merging of meteorological data (see Table A-5 for a summary of the keywords associated with this pathway)
- MP processes related to creating meteorological data files for use in dispersion modeling (see Table A-6 for a summary of the keywords associated with this pathway)

There are four processing tasks that might be involved in any given application. These tasks has been assigned the following two-letter acronyms:

- EX Extraction and storing of data
- QA Quality Assessment
- MR Merge
- MP Process data for use with a specific dispersion model.

The information provided in the columns headed by these two-letter acronyms indicates whether a given keyword is mandatory (M) or optional (O) for the indicated task. If a particular keyword is not relevant or not used for a task then the column is blank.

Appendices A and B are designed to be used together. Appendix A is consulted with a specific task in mind to determine which keyword is needed to specify the task. Appendix B is consulted for syntax and the information needed to employ the keyword.

Table A-1

Summary of Keywords Associated with the JB Pathway

JB keywords	EX	QA	MR	MP	Description and usage
FIN	M	M	M	M	Signals the completion of input data for this pathway.
ERR	M	M	M	M	Defines disk file name for processor generated warning and error messages.
STA	O	O	O	O	Defines the beginning of input data for pathway.
OUT	O	O	O	O	Defines disk file name for the general report.
RUN	O	O	O	O	If present, processing STOPS following completion of processing input images. Useful for checking input images.
END	O	O	O	O	Alternate method for signaling the end of the input data. Default is encountering an End-Of-File (EOF) in reading the input data.

Table A-2

Summary of Keywords Associated with the UA Pathway

UA keywords	EX	QA	MR	MP	Description and usage
FIN	M	M	M		Signals the completion of input data for this pathway.
STA	O	O	O		Defines the beginning of input data for pathway.
LOC	M	M	M		Defines station ID, station longitude and latitude, and number of hours to convert times given in data to LST.
IQA	M	M			Defines disk file name for storage of extracted data and input data for QA processing.
OQA		M	M		Defines disk file name for storage of QA processed data and input data for MERGE.
EXT	M				Defines EXTRACT start and stop dates.
IN1	(M)				Defines tape name, format, and characteristics for upper air data.
IN2	(M)				Defines tape name and characteristics, or disk file name and format for morning and afternoon mixing height data.
TOP	O				Upper air data for altitudes above ground greater than UATOP are ignored. Default value of UATOP is 5000 m.
OFF	O				Turns off automatic data modifications during EXTRACT of upper air soundings. By default adjustments are made to correct suspect temperatures, redefine directions associated with calm winds, delete (when possible) data given for mandatory pressure levels, fill in missing dew-point temperatures, and adjust heights to AGL.
CHK		O			Redefines QA range checks and missing value flag for a variable.
AUD		O			Adds variable to general AUDIT report. Default variables are UAM1 and UAM2, morning and evening mixing heights.
TRA		O			Turns on trace for missing data during QA processing.

(M) One or both of IN1 and IN2 must be present, if EXT is present.

Table A-3

Summary of Keywords Associated with the SF Pathway

SF keywords	EX	QA	MR	MP	Description and usage
FIN	M	M	M		Signals the completion of keyword input for this pathway.
STA	O	O	O		Defines the beginning of keyword input for this pathway.
LOC	M	M	M		Defines station ID, station longitude and latitude, and number of hours to convert times in the data to LST.
IQA	M	M			Defines disk file name for storage of extracted data and input data for QA processing.
OQA		M	M		Defines disk file name for storage of QA processed data and input data for MERGE.
EXT	M				Defines EXTRACT start and stop dates.
IN2	M				Defines tape name and characteristics, or disk file name and format of hourly weather observation data.
IN3	O				Defines the filename and format of the precipitation data file.
CHK		O			Redefines QA range checks and missing value flag for a variable.
AUD		O			Adds variable to general AUDIT report. Default variables are: SLVP Station pressure (adjusted to sea level) PRES Station pressure (unadjusted) CLHT Ceiling height TSKC Total and Opaque sky cover HZVS Horizontal visibility TMPD Dry-bulb temperature WD16 Wind direction WIND Wind speed.
TRA		O			Turns on trace for missing data during QA processing.

Table A-4

Summary of Keywords Associated with the OS Pathway

OS keywords	EX	QA	MR	MP	Description and usage
FIN	M	M	M		Signals the completion of input data for this pathway.
STA	O	O	O		Defines the beginning of input data for pathway.
LOC	M	M	M		Defines site ID, site longitude and latitude, and number of hours to convert times given in data to LST.
IQA	M	M			Defines disk file name for storage of input data for QA processing. May have more than one observation per hour.
OQA		M	M		Defines disk file name for storage of QA processed data and input data for MERGE. Always hourly averages.
EXT	O				Defines EXTRACT start and stop dates.
MAP	M	M	M		Defines order of OS input variables as they appear within IQA file.
FMT	M	M	M		Defines FORTRAN format statements for reading IQA file.
AVG	O	O			Defines maximum number of observations to be expected per hour for input data provided within IQA file.
DT1	O	O			Defines lower and upper measurement heights associated with first temperature difference.
DT2	O	O			Defines lower and upper measurement heights associated with second temperature difference.
DT3	O	O			Defines lower and upper measurement heights associated with third temperature difference.

Table A-4 (continued)

Summary of Keywords Associated with the OS Pathway

HGT	O	O			Defines meteorological mast configuration, number of levels, and height associated with each.
CLM	O	O			Redefines valid minimum wind speed for use in definition of a calm; default = 1 ms^{-1}
CHK		O			Redefines QA range checks and missing value flag for a variable.
AUD		O			Adds variable to general AUDIT report. Default variables are: MHGT Mixing height SA SD of horizontal wind direction SE SD of vertical wind direction TT Dry-bulb temperature WD Horizontal mean wind direction WS Horizontal mean wind speed.
TRA		O			Turns on trace for missing data during QA processing.
SFC		O			Defines surface characteristics. Default values are albedo, 0.25; Bowen ratio, 0.75; and surface roughness length, 0.15 m.

Table A-5

Summary of Keywords Associated with the MR Pathway

MR keywords	EX	QA	MR	MP	Description and usage
OUT			M		Defines disk file name for storage of combined (merged) data.
FIN			M		Signals the completion of input data for this pathway.
EXT			O		Defines start and stop dates for MERGED data.
STA			O		Defines the beginning of input data for pathway.

Table A-6

Summary of Keywords Associated with the MP Pathway

MP keywords	EX	QA	MR	MP	Description and usage
FIN				M	Signals the completion of input data for this pathway.
STA				O	Defines the beginning of input data for pathway.
MET				M	Defines disk file name associated with combined (merged) meteorological data file.
MMP				M	Defines disk file name associated with output meteorological file created by this run. Included as an option is the ability to define the dispersion model that will be accessing this file.
EXT				O	Defines start and stop dates for meteorological data file to be created by this run.
VBL				O	Redefines (override default) processing methodology to be employed in generating output meteorological data file. Currently there are selection options available for processing wind, temperature, stability category, and mixing height. Choice is largely whether to use NWS or on-site meteorological data.
TRA				O	Turns on more detailed trace of errors encountered during processing. Default is to provide daily summaries.
LST				O	Turns on listing of generated meteorology to general report file.

APPENDIX D

EXAMPLE TEST CASES

The example test cases described in this appendix document testing conducted in January 1996 using MPRM (dated 96030). The test case files along with the executables for MPRM are available for downloading from the SCRAM Bulletin Board. Although not exhaustive, the test cases exercise many of features and options encountered in a typical analysis.

File Management

Keeping track of all the files involved in processing data through MPRM can be somewhat troublesome without good file management and simple file naming conventions. The following conventions were used to keep track of the example test case files: 1) files associated with Stage 1 processing have a three digit identifier beginning with the numeral '1' (e.g., TEST1xx.* or *.1xx); 2) files associated with Stage 2 processing have a three digit identifier beginning with the numeral '2' (e.g., TEST2xx.* or *.2xx); 3) files associated with Stage 3 processing have a three digit identifier beginning with the numeral '3' (e.g., TEST3xx.* or *.3xx). In addition the following file extensions are used:

*.RPT	General report files
*.ERR	Error report files
*.INP	Command input files
*.OUT	Model output files

File Name	Size	Date	File Contents
STAGE1N2 EXE	705993	01-30-96	Stage 1 and 2 Executable
STAGE3 EXE	649730	01-30-96	Stage 3 Executable
24157-94 MIX	2835	10-23-95	Mixing Heights
24155-94 DAT	120048	01-30-96	Surface Data (CD-144 format)
LAF-OS MET	112728	12-05-95	On-site Data
24155-94 PPP	5172	01-11-96	Precipitation Data (TD-3240FB)
24155-94 001	3454	01-30-96	Altered Surface Data
24155-94 SAV	2143	01-30-96	Un-altered Surface Data
TEST121 INP	276	12-05-95	Command file for QA of mixing heights
TEST121 ERR	737	01-30-96	Error file from QA of mixing heights
TEST121 RPT	3441	01-30-96	Report file from QA of mixing heights
OQAUA 121	1541	01-30-96	Output from QA of mixing heights
TEST122 INP	361	01-11-96	Command file for QA of NWS data
TEST122 ERR	4891	01-30-96	Error file from QA of NWS data
TEST122 RPT	5058	01-30-96	Report file from QA of NWS data
OQASF 122	116098	01-30-96	Output from QA of NWS data
TEST123 INP	485	12-05-95	Command file for QA of on-site data
TEST123 ERR	6499	01-30-96	Error file from QA of on-site data
TEST123 RPT	4023	01-30-96	Report file from QA of on-site data
OQAOS 123	56601	01-30-96	Output from QA of on-site data
TEST222 INP	242	01-29-96	Command file for merge of NWS data
TEST222 ERR	804	01-30-96	Error file from merge of NWS data
TEST222 RPT	4018	01-30-96	Report file from merge of NWS data
MERGE 222	87316	01-30-96	Output from merge of NWS data
TEST223 INP	288	01-29-96	Command file for on-site merge
TEST223 ERR	1005	01-30-96	Error file from on-site merge
TEST223 RPT	4755	01-30-96	Report file from on-site merge
MERGE 223	121021	01-30-96	Output from on-site merge
TEST322 INP	218	01-29-96	Command file for Stage 3
TEST322 ERR	13021	01-30-96	
TEST322 RPT	20331	01-30-96	
TEST322 OUT	63410	01-30-96	
TEST323 INP	424	01-30-96	Command file for Stage 3
TEST323 ERR	16170	01-30-96	
TEST323 RPT	24429	01-30-96	
TEST323 OUT	55490	01-30-96	
TEST324 INP	926	01-29-96	Command file for Stage 3
TEST324 ERR	16103	01-30-96	
TEST324 RPT	25273	01-30-96	
TEST324 OUT	63410	01-30-96	

Figure D-1 Files associated with the testing of MPRM (dated 96030)

```
JB  STA                                              Start JB input

JB  OUT  DISK  TEST121.RPT                           Defines name for general
                                                     report file

JB  ERR  DISK  TEST121.ERR                           Defines name for error report
                                                     file

JB  FIN                                              Finish JB input


UA  STA                                              Start UA input

UA  IN2  USER 24157-94.MIX (A5,3I2,2X,I4,14X,I4) 24157   Provides information for
                                                     extracting mixing heights

UA  LOC  24157  117.53W  47.63N  0                   Defines location of mixing
                                                     height data

UA  EXT  94 10 31  94 12 01                          Defines time period for
                                                     extraction of mixing heights

UA  IQA  DISK  IQAUA.121                             Defines name for QA input
                                                     file (extracted data file)

UA  OQA  DISK  OQAUA.121                             Defines name for QA output
                                                     file

UA  FIN                                              Finish UA input
```

Figure D-2 Run stream for extraction and quality assurance of NWS mixing height estimates.

```
JB  STA                                                        Start JB input

JB  OUT  DISK  TEST122.RPT                                     Defines name for general
                                                               report file

JB  ERR  DISK  TEST122.ERR                                     Defines name for error report
                                                               file

JB  FIN                                                        Finish JB input


SF  STA                                                        Start SF input

SF  IN2  DISK  24155-94.DAT  CD144FB  24155                    Provides information for
                                                               extracting NWS surface data

SF  IN3  DISK  24155-94.PPP  TD3240FB  9924155                 Provides information for
                                                               extracting precipitation data

SF  LOC  24157  118.85W  45.67N  0                             Defines location of NWS
                                                               surface data

SF  EXT  94 11 01  94 11 30                                    Defines time period for
                                                               extraction of surface data

SF  IQA  DISK  IQAUA.122                                       Defines name for QA input
                                                               file (extracted data file)

SF  OQA  DISK  OQAUA.122                                       Defines name for QA output
                                                               file

SF  AUD  PWTH                                                  Adds present weather (PWTH)
                                                               to the audit report

SF  TRA  PWTH PRES CLHT TSKC TMPT WD16 WIND                    Adds specified variables to
                                                               trace report

SF  FIN                                                        Finish SF input
```

Figure D-3 Run stream for extraction and quality assurance of NWS surface and precipitation data.

```
JB  STA                                                       Start JB input

JB  OUT  DISK  TEST123.RPT                                    Defines name for general
                                                              report file

JB  ERR  DISK  TEST123.ERR                                    Defines name for error report
                                                              file

JB  FIN                                                       Finish JB input


OS  STA                                                       Start OS input

OS  IQA  DISK  LAF-OS.MET                                     Defines name of on-site data
                                                              file

OS  MAP  DAT01  OSYR OSMO OSDY OSHR WS01 TT01 DT01 WD01 SA01 INSO   Defines list of on-site
                                                              variables

OS  FMT  DAT01  (4X, 4I2, F9.1, 9X, 5F9.1)                    Defines format for on-site
                                                              data

OS  LOC  LAFAYE  122.60W  45.50N  0                           Defines location of on-site
                                                              data

OS  EXT  94 11 01  94 11 30                                   Defines time period for
                                                              extraction of on-site data

OS  DT1  2.  20.                                              Defines heights for Delta-T
                                                              measurements

OS  HGT  1   20.                                              Defines heights for multi-
                                                              level variables

OS  CHK  INSO  2  9999     0  700                             Redefines default upper and
                                                              lower bounds for QA of
                                                              insolation

OS  CHK  DT01  1  -999   -10    5                             Redefines default bounds for
                                                              QA of Delta-T

OS  CHK  SA    1    99     0   50                             Redefines default bounds for
                                                              QA of Sigma-Theta

OS  AUD  INSO  DT01                                           Adds insolation and Delta-T
                                                              to the QA audit report

OS  OQA  DISK  OQAUA.123                                      Defines name for QA output
                                                              file

OS  FIN                                                       Finish OS input
```

Figure D-4 Run stream for extraction and quality assurance of on-site data.

JB STA	Start JB input
JB OUT DISK TEST223.RPT	Defines name for general report file
JB ERR DISK TEST223.ERR	Defines name for error report file
JB FIN	Finish JB input
UA STA	Start UA input
UA OQA DISK OQAUA.121	Provides name of upper air output file to merge
UA FIN	Finish UA input
SF STA	Start SF input
SF OQA DISK OQASF.122	Provides name of surface output file to merge
SF FIN	Finish SF input
OS STA	Start OS input
OS OQA DISK OQAOS.123	Provide name of on-site output file to merge
OS FIN	Finish OS input
MR STA	Start MR input
MR EXT 94 11 01 94 11 30	Define time period of data to merge
MR OUT DISK MERGE.223	Define name of merge output file
MR FIN	Finish MR input

Figure D-5 Run stream for merging of NWS mixing height and surface data with on-site data.

JB STA	Start JB input
JB OUT DISK TEST324.RPT	Defines name for general report file
JB ERR DISK TEST324.ERR	Defines name for error report file
JB FIN	Finish JB input
OS STA	Start OS input
OS LOC LAFAYE 122.60W 45.50N 0	Defines on-site location
OS SFC SETUP SEASON 2	Specifies seasonal surface characteristics for 2 sectors
OS SFC SECTORS 1 0 180	Defines bounds for sector 1
OS SFC SECTORS 2 180 360	Defines bounds for sector 2
OS SFC VALUES 1 1 0.50 1.50 0.15 0.50 2.00 0.15 0.	Data for season 1, sector 1
OS SFC VALUES 2 1 0.12 0.70 0.15 1.00 2.00 0.15 0.	Data for season 2, sector 1
OS SFC VALUES 3 1 0.12 0.30 0.15 1.30 2.00 0.15 0.	Data for season 3, sector 1
OS SFC VALUES 4 1 0.12 1.00 0.15 0.80 2.00 0.15 0.	Data for season 4, sector 1
OS SFC VALUES 1 2 0.35 1.50 0.15 1.00 50.00 0.27 0.	Data for season 1, sector 2
OS SFC VALUES 2 2 0.14 1.00 0.15 1.00 50.00 0.27 0.	Data for season 2, sector 2
OS SFC VALUES 3 2 0.16 2.00 0.15 1.00 50.00 0.27 0.	Data for season 3, sector 2
OS SFC VALUES 4 2 0.18 2.00 0.15 1.00 50.00 0.27 0.	Data for season 4, sector 2
OS FIN	Finish OS input
MP STA	Start MP input
MP MET DISK MERGE.223 8	Provides name of merge file to process
MP MMP DISK TEST324.OUT ISCSTWET	Defines output file name and dispersion model
MP VBL WIND ONSITE 10	Defines processing options for wind speed and direction
MP VBL TEMP ONSITE 2	Defines processing options for temperature
MP VBL STAB TTDIFF 10	Defines processing options for stability
MP FIN	Finish MP input

Figure D-6 Run stream for processing NWS and on-site data for use in wet deposition modeling.

```
        METEOROLOGICAL PROCESSOR FOR REGULATORY MODELS [MPRM (dated 96030)]

                            30-JAN-96     10:19:28

               STAGE 1 EXTRACTION AND QA OF METEOROLOGICAL DATA

           ********************************************************
           ***             JOB TERMINATED NORMALLY              ***
           ********************************************************

                 STATUS REPORT PRIOR TO BEGINNING PROCESSOR RUN

 1.  REPORT FILE NAMES

      ERROR MESSAGES: TEST122.ERR
      SUMMARY OF RUN: TEST122.RPT

 2.  UPPER AIR DATA

     THE PROCESS(ES) MPRM ANTICIPATES TO PERFORM ARE:

           NONE - NO DATA TO BE PROCESSED ON THIS PATH

 3.  NWS SURFACE DATA

      SITE ID    LATITUDE(DEG.)   LONGITUDE(DEG.)
        24155       45.67N           118.85W

     THE PROCESS(ES) MPRM ANTICIPATES TO PERFORM ARE:

           EXTRACT AND QUALITY ASSESSMENT

          EXTRACT INPUT -    OPEN: 24155-94.DAT
          EXTRACT OUTPUT-    OPEN: IQASF.122
          QA OUTPUT     -    OPEN: OQASF.122

          THE EXTRACT DATES ARE:    STARTING:  1-NOV-94
                                      ENDING: 30-NOV-94

 4.  ON-SITE DATA

     THE PROCESS(ES) MPRM ANTICIPATES TO PERFORM ARE:

           NONE - NO DATA TO BE PROCESSED ON THIS PATH

                     **** MPRM MESSAGE SUMMARY TABLE ****

        0- 9   10-19   20-29   30-39   40-49   50-59   60-69   70-79   TOTAL
      ----------------------------------------------------------------------

    JB
      E    0       0       0       0       0       0       0       0       0
      W    0       0       0       0       0       0       0       0       0
      I    0       7       0       0       0       0       0       0       7

    SF
      E    0       0       0       0       0       0       0       0       0
      W    0       0       0       0       0       0       0       0       0
      I    0       0       0       0       4       0       0       0       4
      Q    0       0       0       0       0       0       0       0       0
      ----------------------------------------------------------------------
           0       7       0       0       4       0       0       0      11
```

Figure D-7a Report file for extraction and QA of surface data (1 of 2).

```
        METEOROLOGICAL PROCESSOR FOR REGULATORY MODELS [MPRM (dated 96030)]

                            30-JAN-96     10:19:28

               STAGE 1 EXTRACTION AND QA OF METEOROLOGICAL DATA


       ****   WARNING MESSAGES ****

              ---  NONE  ---


       ****    ERROR MESSAGES  ****

              ---  NONE  ---



            ********************************************************
            ***               JOB TERMINATED NORMALLY              ***
            ********************************************************


                       **** SUMMARY OF THE QA AUDIT ****


SURFACE DATA          |------VIOLATION SUMMARY------|   |-----TEST VALUES-----|
              TOTAL     #     LOWER  UPPER      %       MISSING   LOWER   UPPER
              # OBS  MISSING  BOUND  BOUND  ACCEPTED     FLAG     BOUND   BOUND
      SLVP     720       0       0      0     100.00    -9999.0, 9000.0,10999.0
      PRES     720       4       0      0      99.44    -9999.0, 9000.0,10999.0
      CLHT     720      10       0      0      98.61    -9999.0,    0.0,  300.0
      TS       720       2       0      0      99.72       99.0,    0.0,   10.0
        KC     720       1       0      0      99.86       99.0,    0.0,   10.0
      PW       720       0       0      0     100.00       99.0,    0.0,   92.0
        TH     720       0       0      0     100.00       99.0,    0.0,   92.0
      HZVS     720       0       0      0     100.00    -9999.0,    0.0, 1640.0
      TMPD     720       0       0      0     100.00    -9999.0, -300.0,  350.0
      WD16     720       5       0      0      99.31    -9999.0,    0.0,   36.0
      WIND     720       4       0      0      99.44    -9999.0,    0.0,  500.0

NOTE: TEST VALUES MATCH INTERNAL SCALING APPLIED TO VARIABLES
      (SEE APPENDIX C OF THE USER'S GUIDE)


    THE FOLLOWING CHECKS WERE ALSO PERFORMED FOR THE SURFACE QA
      OF   720 REPORTS, THERE WERE
            30 CALM WIND CONDITIONS (WS=0, WD=0)
             0 ZERO WIND SPEEDS WITH NONZERO WIND DIRECTIONS
             0 DEW-POINT GREATER THAN DRY BULB TEMPERATURES
             6 PRECIPIATION & WEATHER MISMATCH
    THE TIMES OF THESE OCCURRENCES CAN BE FOUND IN THE MESSAGE FILE
     WITH QUALIFIERS CLM, ZNZ, DTT & PPT (RESP.)



    THIS CONCLUDES THE AUDIT TRAIL
```

Figure D-7b   Report file for extraction and QA of surface data (2 of 2).

```
       METEOROLOGICAL PROCESSOR FOR REGULATORY MODELS [MPRM (dated 96030)]

                          30-JAN-96     10:24:56

                     STAGE 2  MERGE METEOROLOGICAL DATA

           ********************************************************
           ***             JOB TERMINATED NORMALLY              ***
           ********************************************************

                 STATUS REPORT PRIOR TO BEGINNING PROCESSOR RUN

 1.  REPORT FILE NAMES

      ERROR MESSAGES: TEST223.ERR
      SUMMARY OF RUN: TEST223.RPT


 2.  UPPER AIR DATA

     THE PROCESS(ES) MPRM ANTICIPATES TO PERFORM ARE:

           MERGE ONLY

          QA OUTPUT     -    OPEN: OQAUA.121


 3.  NWS SURFACE DATA

     THE PROCESS(ES) MPRM ANTICIPATES TO PERFORM ARE:

           MERGE ONLY

          QA OUTPUT     -    OPEN: OQASF.122


 4.  ON-SITE DATA

     THE PROCESS(ES) MPRM ANTICIPATES TO PERFORM ARE:

           MERGE ONLY

          QA OUTPUT     -    OPEN: OQAOS.123


 5.  MERGED DATA

      MERGE OUTPUT  -    OPEN: MERGE.223

                 ***** USER INPUT PARAMETERS FOR MERGE *****

                    MERGED DATA BEGIN (YR/MO/DA) 94/11/ 1
                              AND END            94/11/30

                    THE ON-SITE LATITUDE AND LONGITUDE ARE:

                             LATITUDE
                            LONGITUDE
```

Figure D-8a Report file for Stage 2 MERGE (1 of 2)

```
       METEOROLOGICAL PROCESSOR FOR REGULATORY MODELS [MPRM (dated 96030)]

                         30-JAN-96     10:24:56

                    STAGE 2  MERGE METEOROLOGICAL DATA


               ***** DAILY OUTPUT STATISTICS *****
           MO/DA 11/ 1 11/ 2 11/ 3 11/ 4 11/ 5 11/ 6 11/ 7 11/ 8 11/ 9 11/10
NWS  UPPER AIR  SDGS   0     0     0     0     0     0     0     0     0     0
NCDC MIXING  HEIGHTS   6     6     6     6     6     6     6     6     6     6
NWS SFC OBSERVATIONS  24    24    24    24    24    24    24    24    24    24
ON-SITE OBSERVATIONS  24    24    24    24    24    24    24    24    24    24

           MO/DA 11/11 11/12 11/13 11/14 11/15 11/16 11/17 11/18 11/19 11/20
NWS  UPPER AIR  SDGS   0     0     0     0     0     0     0     0     0     0
NCDC MIXING  HEIGHTS   6     6     6     6     6     6     6     6     6     6
NWS SFC OBSERVATIONS  24    24    24    24    24    24    24    24    24    24
ON-SITE OBSERVATIONS  24    24    24    24    24    24    24    24    24    24

           MO/DA 11/21 11/22 11/23 11/24 11/25 11/26 11/27 11/28 11/29 11/30
NWS  UPPER AIR  SDGS   0     0     0     0     0     0     0     0     0     0
NCDC MIXING  HEIGHTS   6     6     6     6     6     6     6     6     6     6
NWS SFC OBSERVATIONS  24    24    24    24    24    24    24    24    24    24
ON-SITE OBSERVATIONS  24    24    24    24    24    24    24    24    24    24


     UPPER AIR OBS. READ:   32
     SURFACE OBS. READ:    720
     ON-SITE OBS. READ:    720

               ***** MERGE PROCESS COMPLETED *****


                  **** MPRM MESSAGE SUMMARY TABLE ****

       0- 9   10-19   20-29   30-39   40-49   50-59   60-69   70-79   TOTAL
      ----------------------------------------------------------------------

   JB
     E    0       0       0       0       0       0       0       0       0
     W    0       1       0       0       0       0       0       0       1
     I    4       7       0       0       0       0       0       0      11

   OS
     E    0       0       0       0       0       0       0       0       0
     W    0       2       0       0       0       0       0       0       2
     I    0       0       0       0       0       0       0       0       0

   MR
     E    0       0       0       0       0       0       0       0       0
     W    0       0       0       0       0       0       0       0       0
     I    0       0       0       0       0       1       0       0       1
      ----------------------------------------------------------------------
          4      10       0       0       0       1       0       0      15

       ****   WARNING MESSAGES ****
        0 JB W12   TEST: SUMMARY: ERROR/OR MISSING OS-LOC CARD
        0 OS W15 AUTCHK: MHGT NOT INPUT: AUDIT & TRACE DISABLED
        0 OS W15 AUTCHK: SE   NOT INPUT: AUDIT & TRACE DISABLED

       ****    ERROR MESSAGES  ****

              ---  NONE  ---
```

Figure D-8b Report file for Stage 2 MERGE (2 of 2)

```
     METEOROLOGICAL PROCESSOR FOR REGULATORY MODELS [MPRM (dated 96030)]

                    30-JAN-96     10:27:33

            STAGE-3 PROCESSING OF MERGED METEOROLOGICAL DATA

                    ********************************
                    *** JOB TERMINATED NORMALLY  ***
                    ********************************


 1. FILENAMES AS DETERMINED DURING SETUP

    TEST324.RPT                                       OPENED   SUCCESSFULLY
    TEST324.ERR                                       OPENED   SUCCESSFULLY
    MERGE.223                                         OPENED   SUCCESSFULLY
    TEST324.OUT                                       OPENED   SUCCESSFULLY


 2. DISPERSION MODEL DEFINED DURING SETUP:   ISCSTWET


 3. PROCESSING OPTIONS SELECTED DURING SETUP
    PROCESS        SCHEME

    WIND           ONSITE
    TEMPERATURE    ONSITE
    MIXING HEIGHTS NWSWXX
    STABILITY      TTDIFF


 4. STABILITY METHODS USED

       NWSWXX     0
       ONSITE     0
       SESITE     0
       SASITE     0
       WNDWXX     0
       TTDIFF   719
       USERIN     0


 5. PROCESSING ASSUMPTIONS

    WIND SPEED/TURB. MEASUREMENT HEIGHT (M):   10.00
    STACK HEIGHT (M)                           10.00
    TEMPERATURE HEIGHT (M)                      2.00


 6. LOCATIONS SPECIFIED IN SETUP

     DATA      SITE     LONGITUDE   LATITUDE
    PATHWAY     ID      (DEGREES)   (DEGREES)

      UA        24157    117.53W      47.63N
      SF        24155    118.85W      45.67N
      OS       LAFAYE    122.60W      45.50N

    *****************************************
    * LONGITUDE AND LATITUDE FOR PROCESSING *
    *         122.60      45.50             *
    *****************************************
```

Figure D-9a Report file for Stage 3 processing (1 of 3)

```
      METEOROLOGICAL PROCESSOR FOR REGULATORY MODELS [MPRM (dated 96030)]

                          30-JAN-96     10:27:33

             STAGE-3 PROCESSING OF MERGED METEOROLOGICAL DATA

   7. OUTPUT FILE NAMES.

      ERROR REPORT FILE:         TEST324.ERR
      MET DATA FOR MODELING:     TEST324.OUT
      HEADER ON OUTPUT FILE:        24157        94     24155        94


   8. SUMMARY OF DATA PROCESSING RESULTS

      VARIABLE            # VALID  # MISSING

      STABILITY              719        1
      WIND SPEED             673        1           46 (Calms)
      WIND DIRECTION         719        1
      RURAL MIXING HEIGHT    719        1
      URBAN MIXING HEIGHT    719        1
      TEMPERATURE            719        1         5.16 (Average)


   9. DISTRIBUTION OF WIND SPEEDS

    WS CLASS    1       2       3       4       5       6
    # HOURS    235.    265.    138.     31.      4.      0.
    AVERAGE    1.38    2.42    4.07    6.38    9.05    0.00


   10. RURAL STABILITY CATAGEORY RESULTS (# HOURS)

           A       B       C      DD      DN      EF
           0      20      41     213     205     240


   11. SURFACE CHARACTERISTICS USED

 Month Sector Albedo    Bowen  z0(meas) z0(appl)  Min. L     Cg    Anth Heat
  --------------------------------------------------------------------------
    1     1   0.5000   1.5000   0.1500   0.5000   2.0000   0.1500   0.0000
    2     1   0.5000   1.5000   0.1500   0.5000   2.0000   0.1500   0.0000
    3     1   0.1200   0.7000   0.1500   1.0000   2.0000   0.1500   0.0000
    4     1   0.1200   0.7000   0.1500   1.0000   2.0000   0.1500   0.0000
    5     1   0.1200   0.7000   0.1500   1.0000   2.0000   0.1500   0.0000
    6     1   0.1200   0.3000   0.1500   1.3000   2.0000   0.1500   0.0000
    7     1   0.1200   0.3000   0.1500   1.3000   2.0000   0.1500   0.0000
    8     1   0.1200   0.3000   0.1500   1.3000   2.0000   0.1500   0.0000
    9     1   0.1200   1.0000   0.1500   0.8000   2.0000   0.1500   0.0000
   10     1   0.1200   1.0000   0.1500   0.8000   2.0000   0.1500   0.0000
   11     1   0.1200   1.0000   0.1500   0.8000   2.0000   0.1500   0.0000
   12     1   0.5000   1.5000   0.1500   0.5000   2.0000   0.1500   0.0000

    1     2   0.3500   1.5000   0.1500   1.0000  50.0000   0.2700   0.0000
    2     2   0.3500   1.5000   0.1500   1.0000  50.0000   0.2700   0.0000
    3     2   0.1400   1.0000   0.1500   1.0000  50.0000   0.2700   0.0000
    4     2   0.1400   1.0000   0.1500   1.0000  50.0000   0.2700   0.0000
    5     2   0.1400   1.0000   0.1500   1.0000  50.0000   0.2700   0.0000
    6     2   0.1600   2.0000   0.1500   1.0000  50.0000   0.2700   0.0000
    7     2   0.1600   2.0000   0.1500   1.0000  50.0000   0.2700   0.0000
    8     2   0.1600   2.0000   0.1500   1.0000  50.0000   0.2700   0.0000
    9     2   0.1800   2.0000   0.1500   1.0000  50.0000   0.2700   0.0000
   10     2   0.1800   2.0000   0.1500   1.0000  50.0000   0.2700   0.0000
   11     2   0.1800   2.0000   0.1500   1.0000  50.0000   0.2700   0.0000
   12     2   0.3500   1.5000   0.1500   1.0000  50.0000   0.2700   0.0000
```

Figure D-9b Report file for Stage 3 processing (2 of 3)

```
       METEOROLOGICAL PROCESSOR FOR REGULATORY MODELS [MPRM (dated 96030)]

                         30-JAN-96     10:27:33

              STAGE-3 PROCESSING OF MERGED METEOROLOGICAL DATA


                    **** MPRM MESSAGE SUMMARY TABLE ****

        0- 9   10-19   20-29   30-39   40-49   50-59   60-69   70-79   TOTAL
      ----------------------------------------------------------------------

   JB
     E    0       0       0       0       0       0       0       0       0
     W    0       0       0       0       0       0       0       0       0
     I    2       0       0       0       0       0       0       0       2

   OS
     E    0       0       0       0       0       0       0       0       0
     W    0       2       0       0       0       0       0       0       2
     I    0       0       0       0       0       0       0       0       0

   MP
     E    0       0       0       0       0       0       0       0       0
     W    0       0       0       0       0       0       0     228     228
     I    1       1       0       0       0       0       0       2       4
     T    0       0       0       0       0       0       0       0       0
      ----------------------------------------------------------------------
          3       3       0       0       0       0       0     230     236

       ****   WARNING MESSAGES ****
        0 OS W15 AUTCHK: MHGT NOT INPUT: AUDIT & TRACE DISABLED
        0 OS W15 AUTCHK: SE   NOT INPUT: AUDIT & TRACE DISABLED
      305 MP W76 DEPMET: NET RAD'N < 0 DURING DAY ON 94305/13
      305 MP W76 DEPMET: NET RAD'N SUSPECT  (  -62.) ON 94305/18
      305 MP W76 DEPMET: NET RAD'N SUSPECT  (  -73.) ON 94305/19
      305 MP W76 DEPMET: NET RAD'N SUSPECT  (  -78.) ON 94305/20
      305 MP W76 DEPMET: NET RAD'N SUSPECT  (  -52.) ON 94305/21
      305 MP W76 DEPMET: NET RAD'N SUSPECT  (  -73.) ON 94305/22
      305 MP W76 DEPMET: NET RAD'N SUSPECT  (  -78.) ON 94305/23
      305 MP W76 DEPMET: NET RAD'N SUSPECT  (  -78.) ON 94305/24
```

Figure D-9c Report file for Stage 3 processing (3 of 3)

```
241579410312  678 4.2 3.0    2  733 2.9 2.6
241579411011 1029 7.9 6.4    1  653 7.5 7.3
241579411021  447 5.0 3.4    1  898 4.1 4.4
241579411031  308 5.4 3.8    1  357 4.7 3.7
241579411042  380 7.0 1.5    1  274 3.0 2.9
241579411052  228 4.3 3.2    2  152 2.4 2.2
241579411062  348 1.0 0.8    2  288 3.5 3.4
241579411071  359 4.5 3.5    1  327 4.9 3.2
241579411081  157 2.5 1.9    2  321 7.1 4.7
241579411091  772 3.1 2.6    1  651 4.5 3.5
241579411102  723 6.5 4.4    2  253 1.2 1.8
241579411111  354 1.7 2.3    2  43011.0 4.9
241579411121  31111.7 5.9    1  248 6.8 5.8
241579411131  171 7.6 4.8    1  262 6.1 6.2
241579411141   67 2.3 2.3    1  338 3.6 2.5
241579411151  668 1.0 1.6    1  254 3.0 3.0
241579411161  143 2.3 2.3    2  254 4.1 3.0
241579411172  66918.8 9.5    1  182 8.6 7.2
241579411181  860 4.0 3.0    1  712 8.2 4.9
241579411191  222 4.8 4.3    2  36512.4 6.7
241579411202 105117.3 8.4    1  383 9.8 6.7
241579411211  872 9.2 5.5    1  541 3.7 3.1
241579411221  141 1.8 1.8    2  107 2.5 2.5
241579411232  333 4.5 3.2    2  251 3.1 2.3
```

Figure D-10 Extract from 24157-94.MIX providing NWS estimated mixing heights

```
FILE:  24155-94.001

This is the altered data for November 1, 1994 for station # 24155.
Selected records have been altered by including missing fields for use
in testing Stage 1 QA processing.  Missing fields have been inserted
beginning with the record for 02:00.

....+....1....+....2....+....3....+....4....+....5....+....6....+....7....+....8
nnnnn  mm  hh                vv          ff           rhh
     yr  dd  ccc       precip         DD  pppp         T                       K
24155941101000085800100010000000006103926142813041040093-8K008-3023-          -
24155941101010085800100010000000006503725172814040038089-6K0084K020-          -
2415594110102   580007001000000007503625162816039037089-7K0123K020-           -
2415594110103   80001000 0000000074036210728160370360 96--K012                -
2415594110104   58001000  000000074036230928160380370 93-7K0163K023-          -
2415594110105   80001000   00000770362110281703903708 9--K025                 -
2415594110106   58001500     000080035251028170400370 82-7K025-6095-          8
2415594110107   28006000     000086036  142819041038083-2K025-7100-           -
2415594110108   80006000     000092036    2820041038083-0M025-6100-           -
2415594110109   25004000     000095035        04203807670M02516100179 2007    5
2415594110110   21004000     000091034        045040066 0M02517100138 2003    1
2415594110111   22004000     000091035        047041063 24025082002
2415594110112---2200400000000000088034281928190470410615540300 82005          5
2415594110113---2200400000000000083035272028180480420612240300 82002          2
2415594110114---2200400000000000083033252028180480410561140300 82001          1
2415594110115---2200300000000000086033262028180470400584140304 82004          3
24155941101162202250300000000000086032271528180450390619240304712049 92209    5
24155941101172202250300000000000095034230528210420380739140305308559 92209    7
2415594110118220250020000000000009603128082821039035073633085692206           4
2415594110119---220020000000000010203125102823041036068313035382503           2
2415594110120---210020000000000010502921072823039034067513040582505           1
2415594110121060550020000000000011002924042825039034067863060882508           6
2415594110122---210020000000000010902922032825037033073423060482504           2
2415594110123---10002000000000001110291904282503703307344 6110                1
```

Key to CD-144 Format:

Code	Field	Variable	
nnnnn	1-5		Station ID
yy	6-7		Year
mm	8-9		Month
dd	10-11		Day of Month
hh	12-13	Hour	
ccc	14-16	CLHT	Ceiling Height (hundreths of feet)
	24-29		Present weather
	24		Thunder Storm
	25-26	PW	Liquid Precip (Rain & Drizzle)
	27-29	TH	Frozen Precip
	32-35		Sea Level Pressure (mb and tenths)
DD	39-40	WD16	Wind Direction (tens of degrees)
ff	41-42	WIND	Wind Speed (knots)
pppp	43-46	PRES	Station Pressure (hundreths of inches)
ttt	47-49	TMPD	Dry Bulb (degrees F)
rhh	53-55		Relative Humidity (percent)
T	56	TS	Total Cloud Cover
K	79	KC	Total Opaque Cloud Cover

Figure D-11 Altered records from 24155-94.DAT for testing Stage 1 QA processing

```
HPD99241500HPCPHI1994100031   2400000005
HPD99241500HPCPHI1994110001   0100000005
HPD99241500HPCPHI1994110001   0400000005
HPD99241500HPCPHI1994110001   0500000005
HPD99241500HPCPHI1994110001   0800000099
HPD99241500HPCPHI1994110001   0900000099
HPD99241500HPCPHI1994110001   1000000099
HPD99241500HPCPHI1994110001   2500000025
HPD99241500HPCPHI1994110002   1600000005
HPD99241500HPCPHI1994110002   1700000005
HPD99241500HPCPHI1994110002   2500000010
HPD99241500HPCPHI1994110004   0600000005
HPD99241500HPCPHI1994110004   0700000005
HPD99241500HPCPHI1994110004   0800000020
HPD99241500HPCPHI1994110004   0900000005
HPD99241500HPCPHI1994110004   1000000005
HPD99241500HPCPHI1994110004   1100000005
HPD99241500HPCPHI1994110004   1200000005
HPD99241500HPCPHI1994110004   1300000005
HPD99241500HPCPHI1994110004   1400000005
HPD99241500HPCPHI1994110004   1500000005
HPD99241500HPCPHI1994110004   1600000005
HPD99241500HPCPHI1994110004   1700000020
HPD99241500HPCPHI1994110004   1800000005
```

Figure D-12 Extract from 24155-94.PPP providing precipation data

```
9411 1 1      2.3             4.4     -1.0    165.0     35.0      0.0
9411 1 2      2.7             4.6     -1.0    168.0     14.0      0.0
9411 1 3      3.0             5.0     -0.9    189.0     15.3      0.0
9411 1 4      3.6             4.9     -1.0    196.0     15.0      0.0
9411 1 5      4.1             5.1     -1.0    206.0     13.5      0.0
9411 1 6      4.0             5.2     -1.0    197.0     13.0      0.0
9411 1 7      3.2             5.3     -0.9    199.0     19.0      0.0
9411 1 8      3.4             5.4     -1.0    206.0     15.2     17.4
9411 1 9      3.2             5.6     -0.9    215.0     14.8     87.2
9411 110      3.4             6.7      0.6    219.0     15.9    275.6
9411 111      4.4             8.0      0.6    215.0     15.7    272.1
9411 112      3.6             6.7      0.0    264.0     23.0    117.2
9411 113      1.7             4.8     -1.0    242.0     24.3     50.2
9411 114      2.2             6.2     -0.5    169.0     27.4    184.9
9411 115      2.0             6.9     -0.6    187.0     21.4    139.6
9411 116      2.4             7.3     -0.3    195.0     18.9     97.7
9411 117      2.1             6.5     -1.2    185.0     17.8     11.2
9411 118      2.7             5.7     -1.2    182.0     14.3      0.0
9411 119      3.0             4.7     -1.4    187.0     14.5      0.0
9411 120      3.1             4.3     -1.4    184.0     15.2      0.0
9411 121      3.1             4.4     -1.2    183.0     15.3      0.0
9411 122      2.1             4.5     -1.2    203.0     25.6      0.0
9411 123      2.2             4.6     -1.1    220.0     18.4      0.0
9411 124      2.0             4.6     -1.0    231.0     20.0      0.0
```

Figure D-13 Extract from LAF-OS.MET providing on-site meteorological data

```
       24155          94       24157          94
9411 1 1 345.0000   2.3000 277.5 4  702.3  702.3   0.1577     195.1  1.0000   1   1.27
9411 1 2 348.0000   2.7000 277.8 4  698.5  698.5   0.1823     159.0  1.0000   1   0.00
9411 1 3   9.0000   3.0000 278.1 4  694.7  694.7   0.2268     100.5  0.8000   1   0.00
9411 1 4  16.0000   3.6000 278.0 4  690.9  690.9   0.3074     186.0  0.8000   1   1.27
9411 1 5  26.0000   4.1000 278.3 4  687.1  687.1   0.3668     260.1  0.8000   1   1.27
9411 1 6  17.0000   4.0000 278.4 4  683.3  683.3   0.3335     161.2  0.8000   0   0.00
9411 1 7  19.0000   3.2000 278.4 4  679.6  679.6   0.2552     128.3  0.8000   0   0.00
9411 1 8  26.0000   3.4000 278.5 4  675.8  675.8   0.2822     157.0  0.8000   0  25.15
9411 1 9  35.0000   3.2000 278.8 4  672.0  672.0   0.3230    -998.0  0.8000   0  25.15
9411 110  39.0000   3.4000 279.9 3  668.2  668.2   0.3974     -95.9  0.8000   0  25.15
9411 111  35.0000   4.4000 281.1 3  664.4  664.4   0.4904    -170.2  0.8000   0   0.00
9411 112  84.0000   3.6000 279.9 4  660.6  660.6   0.3839    -367.0  0.8000   0   0.00
9411 113  62.0000   1.7000 277.9 4  656.8  656.8   0.1493      50.0  0.8000   0   0.00
9411 114 349.0000   2.2000 279.4 3  653.0  653.0   0.2772     -73.2  1.0000   0   0.00
9411 115   7.0000   2.0000 280.0 4  653.0  653.0   0.2334     -97.6  0.8000   0   0.00
9411 116  15.0000   2.4000 280.4 4  653.0  653.0   0.1905      50.0  0.8000   0   0.00
9411 117   5.0000   2.1000 279.6 4  654.0  654.0   0.1692      50.0  0.8000   0   0.00
9411 118   2.0000   2.7000 278.9 4  665.7  665.7   0.2108      51.6  0.8000   0   0.00
9411 119   7.0000   3.0000 277.9 4  677.3  677.3   0.2341      57.1  0.8000   0   0.00
9411 120   4.0000   3.1000 277.4 4  688.9  688.9   0.2416      58.7  0.8000   0   0.00
9411 121   3.0000   3.1000 277.5 4  700.5  700.5   0.2416      68.5  0.8000   0   0.00
9411 122  23.0000   2.1000 277.6 4  712.1  712.1   0.1750      50.0  0.8000   0   0.00
9411 123  40.0000   2.2000 277.8 4  723.7  723.7   0.1816      50.0  0.8000   0   0.00
9411 124  51.0000   2.0000 277.8 4  735.4  735.4   0.1690      50.0  0.8000   0   0.00
```

Figure D-14 Extract from TEST324.OUT providing the first 24 records from the Stage 3 output for ISCSTWET

```
        METEOROLOGICAL PROCESSOR FOR REGULATORY MODELS [MPRM (dated 96030)]

                              30-JAN-96     10:19:19

                  STAGE 1 EXTRACTION AND QA OF METEOROLOGICAL DATA


                         **** SUMMARY OF THE QA AUDIT ****


  MIXING HTS         |------VIOLATION SUMMARY------|   |-----TEST VALUES-----|
              TOTAL     #     LOWER  UPPER     %      MISSING   LOWER   UPPER
              # OBS  MISSING  BOUND  BOUND  ACCEPTED    FLAG    BOUND   BOUND
      UAM1     32        0      0      0    100.00    -9999.0,   50.0, 2500.0
      UAM2     32        0      0      0    100.00    -9999.0,   50.0, 4500.0


  SURFACE DATA       |------VIOLATION SUMMARY------|   |-----TEST VALUES-----|
              TOTAL     #     LOWER  UPPER     %      MISSING   LOWER   UPPER
              # OBS  MISSING  BOUND  BOUND  ACCEPTED    FLAG    BOUND   BOUND
      SLVP    720        0      0      0    100.00    -9999.0, 9000.0,10999.0
      PRES    720        4      0      0     99.44    -9999.0, 9000.0,10999.0
      CLHT    720       10      0      0     98.61    -9999.0,    0.0,  300.0
      TS      720        2      0      0     99.72       99.0,    0.0,   10.0
        KC    720        1      0      0     99.86       99.0,    0.0,   10.0
      PW      720        0      0      0    100.00       99.0,    0.0,   92.0
        TH    720        0      0      0    100.00       99.0,    0.0,   92.0
      HZVS    720        0      0      0    100.00    -9999.0,    0.0, 1640.0
      TMPD    720        0      0      0    100.00    -9999.0, -300.0,  350.0
      WD16    720        5      0      0     99.31    -9999.0,    0.0,   36.0
      WIND    720        4      0      0     99.44    -9999.0,    0.0,  500.0


  SITE SCALARS       |------VIOLATION SUMMARY------|   |-----TEST VALUES-----|
              TOTAL     #     LOWER  UPPER     %      MISSING   LOWER   UPPER
              # OBS  MISSING  BOUND  BOUND  ACCEPTED    FLAG    BOUND   BOUND
      INSO    720        0      0      0    100.00     9999.0,    0.0,  700.0
      DT01    720        0      8     20     96.11     -999.0,  -10.0,    5.0


  SITE VECTORS       |------VIOLATION SUMMARY------|   |-----TEST VALUES-----|
              TOTAL     #     LOWER  UPPER     %      MISSING   LOWER   UPPER
              # OBS  MISSING  BOUND  BOUND  ACCEPTED    FLAG    BOUND   BOUND
                                    20.00 M
      SA      720        1      0     15     97.78       99.0,    0.0,   50.0
      TT      720        1      0      0     99.86       99.0,  -30.0,   35.0
      WD      720        1      0      0     99.86      999.0,    0.0,  360.0
      WS      720        1      0      0     99.86      999.0,    0.0,   50.0


   THE FOLLOWING CHECKS WERE ALSO PERFORMED FOR THE SURFACE QA
       OF   720 REPORTS, THERE WERE
             30 CALM WIND CONDITIONS (WS=0, WD=0)
              0 ZERO WIND SPEEDS WITH NONZERO WIND DIRECTIONS
              0 DEW-POINT GREATER THAN DRY BULB TEMPERATURES
              6 PRECIPIATION & WEATHER MISMATCH
     THE TIMES OF THESE OCCURRENCES CAN BE FOUND IN THE MESSAGE FILE
      WITH QUALIFIERS CLM, ZNZ, DTT & PPT (RESP.)

                        THIS CONCLUDES THE AUDIT TRAIL
```

Figure D-15 Summary of Stage 1 QA audit results for UA, SF, OS pathways.

```
  15 JB I19  SETUP: FOUND "END OF FILE" ON DEVICE DEVIN  5
   0 JB I10   TEST: SUMMARY: NO UA-EXT CARD, NULL EXTRACT
   0 JB I11   TEST: SUMMARY: NO UA-IQA CARD, NULL QA
   0 JB I12   TEST: SUMMARY: NO UA-OQA CARD, NULL MERGE
   0 JB I10   TEST: SUMMARY: NO OS-EXT CARD, NULL EXTRACT
   0 JB I11   TEST: SUMMARY: NO OS-IQA CARD, NULL QA
   0 JB I12   TEST: SUMMARY: NO OS-OQA CARD, NULL MERGE
   0 SF I40  SFEXT: *** HLY SFC OBS & PRECIP EXTRACTION ***
 720 SF I49 RD144D: END-OF DATA WINDOW AFTER RECORD  721
   0 SF I49  SFEXT:  720 HLY WX &  720 PRECIP OBS EXTRACTED
30502 SF     SFQASM: CLHT MISSING ON  94/11/01/02
30502 SF PPT SFQASM: WEATHER WITHOUT PRECIP ON 94/11/01/02
30503 SF     SFQASM: CLHT MISSING ON  94/11/01/03
30504 SF     SFQASM: CLHT MISSING ON  94/11/01/04
30504 SF PPT SFQASM: PRECIP WITHOUT WEATHER ON 94/11/01/04
30505 SF     SFQASM: CLHT MISSING ON  94/11/01/05
30505 SF PPT SFQASM: PRECIP WITHOUT WEATHER ON 94/11/01/05
30506 SF     SFQASM: CLHT MISSING ON  94/11/01/06
30507 SF     SFQASM: CLHT MISSING ON  94/11/01/07
30507 SF     SFQASM: WD16 MISSING ON  94/11/01/07
30508 SF     SFQASM: CLHT MISSING ON  94/11/01/08
30508 SF     SFQASM: WD16 MISSING ON  94/11/01/08
30508 SF     SFQASM: WIND MISSING ON  94/11/01/08
30508 SF PPT SFQASM: PRECIP WITHOUT WEATHER ON 94/11/01/08
30509 SF     SFQASM: PRES MISSING ON  94/11/01/09
30509 SF     SFQASM: CLHT MISSING ON  94/11/01/09
30509 SF     SFQASM: WD16 MISSING ON  94/11/01/09
30509 SF     SFQASM: WIND MISSING ON  94/11/01/09
30509 SF PPT SFQASM: PRECIP WITHOUT WEATHER ON 94/11/01/09
30510 SF     SFQASM: PRES MISSING ON  94/11/01/10
30510 SF     SFQASM: CLHT MISSING ON  94/11/01/10
30510 SF     SFQASM: TSKC MISSING ON  94/11/01/10
30510 SF     SFQASM: WD16 MISSING ON  94/11/01/10
30510 SF     SFQASM: WIND MISSING ON  94/11/01/10
30510 SF PPT SFQASM: PRECIP WITHOUT WEATHER ON 94/11/01/10
30511 SF     SFQASM: PRES MISSING ON  94/11/01/11
30511 SF     SFQASM: CLHT MISSING ON  94/11/01/11
30511 SF     SFQASM: TSKC MISSING ON  94/11/01/11
30511 SF     SFQASM: TSKC MISSING ON  94/11/01/11
30511 SF     SFQASM: WD16 MISSING ON  94/11/01/11
30511 SF     SFQASM: WIND MISSING ON  94/11/01/11
30602 SF     SFQASM: PRES MISSING ON  94/11/02/02
30905 SF CLM SFQASM: CALM WINDS ON 94/11/05/05
30906 SF CLM SFQASM: CALM WINDS ON 94/11/05/06
30907 SF CLM SFQASM: CALM WINDS ON 94/11/05/07
30909 SF CLM SFQASM: CALM WINDS ON 94/11/05/09
30922 SF CLM SFQASM: CALM WINDS ON 94/11/05/22
31006 SF CLM SFQASM: CALM WINDS ON 94/11/06/06
                            .
                            .
                            .
  721 SF I49 SFQASM: END OF FILE AFTER OBS #720
```

Figure D-16 Extract from the Stage 1 error report for the SF pathway.

METEOROLOGICAL PROCESSOR FOR REGULATORY MODELS [MPRM (dated 96030)]

30-JAN-96 10:24:56

STAGE 2 MERGE METEOROLOGICAL DATA

***** DAILY OUTPUT STATISTICS *****

MO/DA	11/ 1	11/ 2	11/ 3	11/ 4	11/ 5	11/ 6	11/ 7	11/ 8	11/ 9	11/10
NWS UPPER AIR SDGS	0	0	0	0	0	0	0	0	0	0
NCDC MIXING HEIGHTS	6	6	6	6	6	6	6	6	6	6
NWS SFC OBSERVATIONS	24	24	24	24	24	24	24	24	24	24
ON-SITE OBSERVATIONS	24	24	24	24	24	24	24	24	24	24

MO/DA	11/11	11/12	11/13	11/14	11/15	11/16	11/17	11/18	11/19	11/20
NWS UPPER AIR SDGS	0	0	0	0	0	0	0	0	0	0
NCDC MIXING HEIGHTS	6	6	6	6	6	6	6	6	6	6
NWS SFC OBSERVATIONS	24	24	24	24	24	24	24	24	24	24
ON-SITE OBSERVATIONS	24	24	24	24	24	24	24	24	24	24

MO/DA	11/21	11/22	11/23	11/24	11/25	11/26	11/27	11/28	11/29	11/30
NWS UPPER AIR SDGS	0	0	0	0	0	0	0	0	0	0
NCDC MIXING HEIGHTS	6	6	6	6	6	6	6	6	6	6
NWS SFC OBSERVATIONS	24	24	24	24	24	24	24	24	24	24
ON-SITE OBSERVATIONS	24	24	24	24	24	24	24	24	24	24

UPPER AIR OBS. READ: 32
SURFACE OBS. READ: 720
ON-SITE OBS. READ: 720

***** MERGE PROCESS COMPLETED *****

Figure D-17 Extract from the Stage 2 (MERGE) report file.

METEOROLOGICAL PROCESSOR FOR REGULATORY MODELS [MPRM (dated 96030)]

30-JAN-96 10:27:11

STAGE-3 PROCESSING OF MERGED METEOROLOGICAL DATA

10. RURAL STABILITY CATAGEORY RESULTS (# HOURS)

	A	B	C	DD	DN	EF
TEST322	0	12	38	225	248	197
TEST323	39	40	151	44	240	205
TEST324	0	20	41	213	205	240

Figure D-18 Extract from Stage 3 report files summarizing results of stability classification.

METEOROLOGICAL PROCESSOR FOR REGULATORY MODELS (MPRM), VERSION 1.2

TODAY'S DATE AND TIME: 28-APR-88 AT 15:23:37
PROCESSING OF MERGED METEOROLOGICAL DATA

METEOROLOGICAL JOINT FREQUENCY FUNCTION

STABILITY CATEGORY DN — WIND SPEED CLASS

WIND DIRECTION	SECTOR	1	2	3	4	5	6
N	1	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
NNE	2	0.000000	0.000000	0.010526	0.010526	0.000000	0.000000
NE	3	0.000000	0.000000	0.000000	0.052632	0.010526	0.000000
ENE	4	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
E	5	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ESE	6	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
SE	7	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
SSE	8	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
S	9	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
SSW	10	0.000000	0.000000	0.000000	0.115789	0.000000	0.000000
SW	11	0.000000	0.000000	0.000000	0.105263	0.073684	0.000000
WSW	12	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
W	13	0.000000	0.000000	0.010526	0.010526	0.000000	0.000000
WNW	14	0.000000	0.000000	0.000000	0.021053	0.010526	0.000000
NW	15	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
NNW	16	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000

STABILITY CATEGORY EF — WIND SPEED CLASS

WIND DIRECTION	SECTOR	1	2	3	4	5	6
N	1	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
NNE	2	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
NE	3	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ENE	4	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
E	5	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ESE	6	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
SE	7	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
SSE	8	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
S	9	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
SSW	10	0.000000	0.052632	0.010526	0.000000	0.000000	0.000000
SW	11	0.000000	0.021053	0.010526	0.000000	0.000000	0.000000
WSW	12	0.000000	0.000000	0.063158	0.000000	0.000000	0.000000
W	13	0.000000	0.000000	0.031579	0.000000	0.000000	0.000000
WNW	14	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
NW	15	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
NNW	16	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000

Figure D-19 Portion of listing of joint frequency distribution for use with the CDM16 dispersion model.

METEOROLOGICAL PROCESSOR FOR REGULATORY MODELS (MPRM), VERSION 1.2

TODAY'S DATE AND TIME: 28-APR-88 AT 15:23:37
PROCESSING OF MERGED METEOROLOGICAL DATA

METEOROLOGICAL JOINT FREQUENCY FUNCTION

STABILITY CATEGORY DN

		WIND SPEED CLASS					
WIND DIRECTION	SECTOR	1	2	3	4	5	6
355-005	1	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
005-015	2	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
015-025	3	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
025-035	4	0.000000	0.000000	0.010526	0.010526	0.000000	0.000000
035-045	5	0.000000	0.000000	0.000000	0.031579	0.000000	0.000000
045-055	6	0.000000	0.000000	0.000000	0.021053	0.000000	0.000000
055-065	7	0.000000	0.000000	0.000000	0.000000	0.010526	0.000000
065-075	8	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
075-085	9	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
085-095	10	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
095-105	11	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
105-115	12	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
115-125	13	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
125-135	14	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
135-145	15	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
145-155	16	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
155-165	17	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
165-175	18	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
175-185	19	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
185-195	20	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
195-205	21	0.000000	0.000000	0.000000	0.031579	0.000000	0/000000
205-215	22	0.000000	0.000000	0.000000	0.073684	0.010526	0.000000
215-225	23	0.000000	0.000000	0.000000	0.073684	0.063158	0.000000
225-235	24	0.000000	0.000000	0.000000	0.031579	0.000000	0.000000
235-245	25	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
245-255	26	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
255-265	27	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
265-275	28	0.000000	0.000000	0.010526	0.010526	0.000000	0.000000
275-285	29	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
285-295	30	0.000000	0.000000	0.000000	0.021053	0.010526	0.000000
295-305	31	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
305-315	32	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
315-325	33	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
325-335	34	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
335-345	35	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
345-355	36	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000

Figure D-20 Portion of listing of joint frequency distribution for use with the CDM36 dispersion model.

```
      METEOROLOGICAL PROCESSOR FOR REGULATORY MODELS (MPRM), VERSION 1.2

                 TODAY'S DATE AND TIME: 18-APR-88 AT 07:56:39
                  PROCESSING OF MERGED METEOROLOGICAL DATA

    64  1 1    31.   9.2  511.    4.  23.0
    64  1 2    48.  15.0  483.    4.  21.9
    64  1 3    44.  15.0  456.    4.  23.0
    64  1 4    43.  12.7  429.    4.  23.0
    64  1 5    33.  12.7  401.    4.  24.1
    64  1 6    42.  13.9  374.    4.  24.1
    64  1 7    55.  20.8  347.    4.  26.1
    64  1 8    53.  17.2  319.    4.  26.1
    64  1 9     7.  13.9  292.    4.  25.0
    64  110   331.  10.3  264.    4.  24.1
    64  111   344.  12.7  237.    4.  26.1
    64  112   356.  13.9  210.    4.  27.0
    64  113   343.  10.3  182.    4.  27.0
    64  114   299.   8.1  155.    4.  28.9
    64  115   292.  12.7  155.    4.  28.9
    64  116   274.  13.9  155.    4.  28.9
    64  117   261.  10.3  155.    4.  28.0
    64  118   237.   8.1  168.    5.  21.9
    64  119   224.   9.2  189.    5.  21.9
    64  120   227.  12.7  210.    4.  21.9
    64  121   210.  18.3  231.    4.  24.1
    64  122   232.  16.1  252.    4.  25.0
    64  123   210.  13.9  272.    4.  23.0
    64  124   200.  17.2  293.    4.  24.1

    64  2 1   206.  16.1  314.    4.  24.1
    64  2 2   222.  13.9  335.    4.  23.0
    64  2 3   222.  16.1  355.    4.  23.0
    64  2 4   230.  18.3  376.    4.  23.0
    64  2 5   216.  15.0  397.    4.  23.0
    64  2 6   217.  16.1  418.    4.  23.0
    64  2 7   219.  15.0  438.    4.  23.0
    64  2 8   216.  12.7  459.    4.  21.9
    64  2 9   220.  15.0  480.    4.  23.0
    64  210   221.  15.0  501.    4.  26.1
    64  211   235.  15.0  522.    4.  28.9
    64  212   211.  15.0  542.    4.  33.1
    64  213   209.  16.1  563.    4.  35.1
    64  214   207.  16.1  584.    4.  37.0
    64  215   200.  15.0  584.    4.  39.9
                       .
                       .
                       .
```

Figure D-21 Portion of listing of meteorological data for use with the RTDM dispersion model.

```
METEOROLOGICAL PROCESSOR FOR REGULATORY MODELS (MPRM), VERSION 1.2

          TODAY'S DATE AND TIME: 18-APR-88 AT 07:58:02
            PROCESSING OF MERGED METEOROLOGICAL DATA

64  1 1   4.1  31.0  4 1000.0    0.0
64  1 2   6.7  48.0  4 1000.0    0.0
64  1 3   6.7  44.0  4 1000.0    0.0
64  1 4   5.7  43.0  4 1000.0    0.0
64  1 5   5.7  33.0  4 1000.0    0.0
64  1 6   6.2  42.0  4 1000.0    0.0
64  1 7   9.3  55.0  4 1000.0    0.0
64  1 8   7.7  53.0  4 1000.0    0.0
64  1 9   6.2   7.0  4 1000.0    0.0
64  110   4.6 331.0  4 1000.0    0.0
64  111   5.7 344.0  4 1000.0    0.0
64  112   6.2 356.0  4 1000.0    0.0
64  113   4.6 343.0  4 1000.0    0.0
64  114   3.6 299.0  4 1000.0    0.0
64  115   5.7 292.0  4 1000.0    0.0
64  116   6.2 274.0  4 1000.0    0.0
64  117   4.6 261.0  4 1000.0    0.0
64  118   3.6 237.0  5 1000.0    0.0
64  119   4.1 224.0  5 1000.0    0.0
64  120   5.7 227.0  4 1000.0    0.0
64  121   8.2 210.0  4 1000.0    0.0
64  122   7.2 232.0  4 1000.0    0.0
64  123   6.2 210.0  4 1000.0    0.0
64  124   7.7 200.0  4 1000.0    0.0

64  2 1   7.2 206.0  4 1000.0    0.0
64  2 2   6.2 222.0  4 1000.0    0.0
64  2 3   7.2 222.0  4 1000.0    0.0
64  2 4   8.2 230.0  4 1000.0    0.0
64  2 5   6.7 216.0  4 1000.0    0.0
64  2 6   7.2 217.0  4 1000.0    0.0
64  2 7   6.7 219.0  4 1000.0    0.0
64  2 8   5.7 216.0  4 1000.0    0.0
64  2 9   6.7 220.0  4 1000.0    0.0
64  210   6.7 221.0  4 1000.0    0.0
64  211   6.7 235.0  4 1000.0    0.0
64  212   6.7 211.0  4 1000.0    0.0
64  213   7.2 209.0  4 1000.0    0.0
64  214   7.2 207.0  4 1000.0    0.0
64  215   6.7 200.0  4 1000.0    0.0
64  216   7.2 204.0  4 1000.0    0.0
64  217   8.2 198.0  4 1000.0    0.0
64  218   6.2 201.0  4 1000.0    0.0
64  219   6.7 202.0  4 1000.0    0.0
64  220   6.2 205.0  4 1000.0    0.0
64  221   8.8 214.0  4 1000.0    0.0
64  222   9.3 215.0  4 1000.0    0.0
64  223   9.8 217.0  4 1000.0    0.0
                 .
                 .
                 .
```

Figure D-22 Portion of listing of meteorological data for use with the CALINE-3 dispersion model.

APPENDIX C

VARIABLE NAMES AND DEFAULT RANGE CHECKS

MPRM gives the user the ability to override the internal definitions for upper and lower bounds, missing value indicator, and treatment of endpoints during quality assessment checks during Stage 1 processing. This appendix presents the following:

- Variable names used to override the parameters
- A description of each variable and the units used
- Quality assessment default parameters for each variable
- Variables automatically audited during quality assessment.

There are seven fields in each table: variable name, description, units, range check switch, missing flag, lower bound, and upper bound. Each of these fields is described below.

Variable name
This is the four-character variable name used in the input images for redefining quality assessment parameters (the CHK image on each pathway), activating auditing of variables not automatically audited (the AUD image on each pathway) and defining the on-site data map (the DAT and LVL images only on the OS-pathway).

If an asterisk (*) appears before the variable name, then the variable is automatically audited during quality assessment. These variables are always audited on the upper air and surface pathways. However, for the on-site pathway if the variable is not in the data map, then the variable is omitted from the audit. If a person wants to audit additional variables on any pathway, the AUD input image is used.

Description and units
A brief description and the units of each variable follows the name. For several variables, a multiplier also appears in the units field. This can be identified by the *10, *100, or *1000 following the units. Because the upper air and surface observations are treated as integers within MPRM, multipliers are used to retain significant digits prior to rounding the value to the nearest integer.

Range Check Switch
The Range Check Switch field indicates whether to exclude the lower and upper bound (= 1) or include the bounds (= 2) in determining if the variable violates the prescribed limits. This value can be changed by using the CHK input image.

Missing Value Indicator
The missing value indicator is the value used in the processor to represent missing data for the variable. This value can be changed by the user on the CHK input image. This option is particularly useful if data are already extracted and a different missing value flag was used.

Bounds
The last two fields, the Lower and Upper bounds, are the limits against which the value of a variable is checked. If the value lies outside this interval, the endpoints either included or excluded according to the Range Check Switch, then a quality

assessment violation is recorded. As in the Range Check Switch and Missing Flag, these values can be modified using the CHK card.

If upper air soundings are to be extracted, an upper height limit is used above which no data are extracted. The default height limit is 5000 meters. The value of the height limit is stored in a variable named UATOP. The user can override this value by specifying a new height on the UA TOP input image for the upper air pathway. A description of this image and its syntax can be found in Appendix B.

Note: The maximum number of levels that can be extracted is set in the processor to 20. If 20 levels of data are extracted and UATOP has not been reached, no additional data are extracted.

On the OS-pathway there are several variables with default values that can be redefined using an input run-stream image. These include the number of observations per hour (default value 1) and threshold wind speed (default value 1.0 m/s). The number of observations per hour can be redefined using the OS AVG input image. The threshold wind speed can be redefined using the OS CLM input image. In addition, the various parameters defining surface characteristics are also given default values; these can be redefined using the OS SFC VALUES input image (see Section 4.2.5).

Table C-1

Variable Names, Units, and QA Default Settings for the UA Pathway

Variable name	Description	Units	Range check switch	Missing value indicator	Bounds Lower	Bounds Upper
UAPR	Atmospheric pressure	millibars *10	1	-9999	5000	10999
UAHT	Height above ground level	meters	2	-9999	0	5000
UATT	Dry bulb temperature	°C *10	1	-9999	-350	+350
UATD	Dew-point temperature	°C *10	1	-9999	-350	+350
UAWD	Wind direction	degrees from north	2	-9999	0	360
UAWS	Wind speed	meters/second *10	2	-9999	0	500
UASS	Wind speed shear	(m/s)/(100 meters)	2	-9999	0	5
UADS	Wind direction shear	degrees/(100 meters)	2	-9999	0	90
UALR	Temperature lapse rate	°C/(100 meters)	2	-9999	-2	5
UADD	Dew point deviation	°C/(100 meters)	2	-9999	0	2
UAM1*	A.M. Mixing height	meters	2	-9999	50	2500
UAM2*	P.M. Mixing height	meters	2	-9999	50	4500

*Automatically included in audit report.

Table C-2

Variable Names, Units, and QA Default Settings for the SF Pathway

Variable name	Description	Units	Range check switch	Missing value indicator	Bounds Lower	Bounds Upper
ALTP	Altimeter pressure	inches of mercury	2	-9999	2700	3200
SLVP*	Sea level pressure	millibars *10	1	-9999	9000	10999
PRES*	Station pressure	millibars *10	1	-9999	9000	10999
CLHT*	Ceiling height	kilometers *10	2	-9999	0	300
TSKC*	Total//opaque sky cover	tenths//tenths	2	9999	0	1010
C2C3	2 level//3 level cloud cover	tenths//tenths	2	9999	0	1010
CLC1	Sky condition//cover, level 1	------//tenths	2	9999	0	910
CLC2	Sky condition//cover, level 2	------//tenths	2	9999	0	910
CLC3	Sky condition//cover, level 3	------//tenths	2	9999	0	910
CLC4	Sky condition//cover, level 4	------//tenths	2	9999	0	910
CLT1	Cloud type//height, level 1	------//(km *10)	2	99999	0	98300
CLT2	Cloud type//height, level 2	------//(km *10)	2	99999	0	98300
CLT3	Cloud type//height, level 3	------//(km *10)	2	99999	0	98300
CLT4	Cloud type//height, level 4	------//(km *10)	2	99999	0	98300
PWTH	Present weather (2 types)	------//-----	2	9999	0	9292
HZVS*	Horizontal visibility	kilometers *10	2	-9999	0	1640
TMPD*	Dry bulb temperature	°C *10	1	-9999	-300	350
TMPW	Wet bulb temperature	°C *10	1	-9999	-650	350
DPTP	Dew-point temperature	°C *10	1	-9999	-650	350
RHUM	Relative humidity	whole percent	2	-9999	0	100
WD16*	Wind direction	tens of degrees	2	-9999	0	36
WIND*	Wind speed	meters/second *10	2	-9999	0	500
PRCP	Precipitation amount	millimeters * 1000	2	-9	0	25400
SF01	Not in use		1	999	0	100
SF02	Not in use		1	999	0	100
SF03	Not in use		1	999	0	100

NOTES: The three pressure variables (ALTP, SLVP, and PRES), the ceiling height (CLHT) and the sky cover (TSKC) are also available on the OS-pathway.

Surface data reported by the NWS are archived as reported, in English units - MPRM converts the surface data to mks units prior to QA. Thus, with the exception of the altimeter setting, all range check bounds are given in mks units.

SF01, SF02 and SF03 were added to allow for future enhancements to MPRM on the SF pathway.

* Automatically included in audit report.

// The two variables described have been combined to form one variable.

Table C-3

Variable Names, Units, and QA Default Settings for the OS Pathway

Variable name	Description	Units	Range check switch	Missing value indicator	Bounds Lower	Bounds Upper
HFLX	Surface heat flux	watts/square meter	1	999	-50	800
USTR	Surface friction velocity	meters/second	1	999	0	2
MHGT*	Mixing height	meters	1	9999	0	4000
ZOHT	Surface roughness length	meters	1	999	0	2
SAMT	Snow amount	centimeters	2	999	0	250
PAMT	Precipitation amount	centimeters	2	999	0	100
INSO	Insolation	watts/square meter	1	9999	0	1250
NRAD	Net radiation	watts/square meter	1	999	-50	800
DT01	Temperature diff.(U - L)[1]	°C	1	-999	-200	500
DT02	Temperature diff.(U - L)[1]	°C	1	-999	-200	500
DT03	Temperature diff.(U - L)[1]	°C	1	-999	-200	500
US01	User's scalar #1	user's units	1	999	0	100
US02	User's scalar #2	user's units	1	999	0	100
US03	User's scalar #3	user's units	1	999	0	100
HTnn	Height	meters	1	9999	0	4000
SAnn*	Std. dev. horizontal wind	degrees	1	99	0	35
SEnn*	Std. dev. vertical wind	degrees	1	99	0	25
SVnn	Std. dev. v-comp. of wind	meters/second	1	99	0	3
SWnn	Std. dev. w-comp. of wind	meters/second	1	99	0	3
SUnn	Std. dev. u-comp. of wind	meters/second	1	99	0	3
TTnn*	Temperature	°C	1	99	-30	35
WDnn*	Wind direction	degrees from north	2	999	0	360
WSnn*	Wind speed	meters/second	2	999	0	50
VVnn	Vertical component of wind	meters/second	1	999	0	5
DPnn	Dew-point temperature	°C	1	99	-65	35
RHnn	Relative humidity	whole percent	2	999	0	100
V1nn	User's vector #1	user's units	1	999	0	100
V2nn	User's vector #2	user's units	1	999	0	100
V3nn	User's vector #3	user's units	1	999	0	100
ALTP	Altimeter pressure	inches of mercury *100	2	-9999	2700	3200
SLVP*	Sea level pressure	millibars *10	1	-9999	9000	10999
PRES*	Station pressure	millibars *10	1	-9999	9000	10999
CLHT*	Ceiling height	kilometers *10	2	-9999	0	300
TSKC*	Sky cover (total or opaque)	tenths	2	99	0	10
OSDY	Day		2	-9	1	31
OSMO	Month		2	-9	1	12
OSYR	Year		2	-9	0	99
OSHR	Hour		2	-9	0	24
OSMN	Minute		2	-9	0	60

[1](U - L) indicates (upper level) - (lower level).
*Automatically included in audit report.
Note that the units for temperature difference are °C. However, the range check for temperature differences is based on the temperature gradient in °C/(100 meters).

Notes: The nn in variables HT to V3 refers to the level at which the observation was taken; e.g., TT01 is temperature at the first level, WS02 is wind speed at the second level.
The three pressure variables (ALTP, SLVP, and PRES), the ceiling height (CLHT), and the sky cover (TSKC) are also available on the surface pathway.

APPENDIX B

SUMMARY OF INPUT SYNTAX

Appendices A and B are designed to be used together. Appendix A is consulted with a specific task in mind to determine which keyword is needed to specify the task. Appendix B is consulted for syntax and the information needed to employ the keyword.

In the following tables, the keywords used in the input to the MPRM processor are presented in more detail. Table B-1 provides information on keywords which are used in specifying files associated with Stage 1 processing. Table B-2 provides information and syntax for the keywords which are used in defining these files (the IN1, IN2, and IN3 keywords). These keywords are presented first, as they are likely to be consulted most often. Table B-3 provides the syntax for the remaining keywords, arranged in alphabetical order by keyword.

Table B-1

Keywords and files associated with Stage 1

Pathway	Keyword	Device	Form or Format	Description
JB	ERR	DISK	Text	Error/message file
	OUT	DISK	Text	General report file
UA, SF & OS	IQA	DISK		Unprocessed data before QA
	OQA	DISK		Unprocessed data after QA
UA	IN1	TAPE	TD5600FB	Unprocessed upper air data
			TD5600VB	Unprocessed upper air data
UA	IN2	TAPE	TD9689FB	NCDC estimated mixing heights
		DISK	TD9689FB	NCDC estimated mixing heights
		USER	User Specified	NCDC estimated mixing heights
SF	IN2	TAPE	CD144FB	NWS surface data
SF	IN2	DISK	CD144FB	NWS surface data
			SCRAMFB	NWS surface data
			SAMSON	NWS surface data
SF	IN3	DISK	TD3240FB	NWS hourly precipitation
			TD3240VB	NWS hourly precipitation

Table B-2

Syntax for Keywords Used in Defining Files for Stage 1

Keyword:	**IN1** used on pathway UA	
Purpose:	Define input tape file for upper air data	
Syntax:	Pathway **IN1** Parm1 Parm2 Parm3 Parm4 Parm5	
Parm1:	Parm1 is always **TAPE**	
Parm2:	Parm2 is the name of the tape file	
Parm3:	Parm3 is the tape file format:	**5600FB** for fixed block or **5600VB** for variable block
Parm4:	Parm4 is the character set:	**ASCII** or **EBCDIC**
Parm5:	Parm5 is the WBAN number of the observation station	
Example:	UA **IN1** **TAPE** filename 5600FB ASCII 13840	

Keyword:	**IN2** used on pathway UA	
Purpose:	Define input tape file for mixing height data	
Syntax:	Pathway **IN2** Parm1 Parm2 Parm3 Parm4 Parm5	
Parm1:	Parm1 is always **TAPE**	
Parm2:	Parm2 is the name of the tape file	
Parm3:	Parm3 is the tape file format:	**9689FB**
Parm4:	Parm4 is the character set:	**ASCII** or **EBCDIC**
Parm5:	Parm5 is the WBAN number of the observation station	
Example:	UA **IN2** **TAPE** filename 9689FB ASCII 13840	

Table B-2 (continued)

Syntax for Keywords Used in Defining Files for Stage 1

Keyword:	**IN2** used on pathway UA
Purpose:	Define input disk file for mixing height data
Syntax:	Pathway **IN2** Parm1 Parm2 Parm3 Parm4
Parm1:	Parm1 is always **DISK**
Parm2:	Parm2 is the name of the tape file
Parm3:	Parm3 is the disk file format: **9689FB**
Parm4:	Parm4 is the WBAN number of the observation station
Example:	UA **IN2** **DISK** filename 5600FB 13840

Keyword:	**IN2** used on pathway UA
Purpose:	Define input user disk file for mixing height data
Syntax:	Pathway **IN2** Parm1 Parm2 Parm3 Parm4
Parm1:	Parm1 is always **USER**
Parm2:	Parm2 is the name of the disk file
Parm3:	Parm3 is a user specified format for the mixing height data. Must be a valid Fortran format. The input list is of the form: AAAAA, YEAR, MONTH, DAY, UAM1, UAM2. Where AAAAA is a 5-character station ID. YEAR, MONTH, and DAY are 2-digit integer variables . UAM1 and UAM2 are morning and afternoon mixing heights (read as 4-digit integer variables).
Parm4:	Parm4 is the WBAN number of the observation station
Example:	UA **IN2** **USER** filename (A5, 3I2, 2X, I4, 14X, I4) 24157

Table B-2 (continued)

Syntax for Keywords Used in Defining Files for Stage 1

Keyword:	**IN2** used on pathway SF	
Purpose:	Define input tape file for NWS surface data	
Syntax:	Pathway **IN2** Parm1 Parm2 Parm3 Parm4 Parm5	
Parm1:	Parm1 is always **TAPE**	
Parm2:	Parm2 is the name of the tape file	
Parm3:	Parm3 is the tape file format:	**CD144FB**
Parm4:	Parm4 is the character set:	**ASCII** or **EBCDID**
Parm5:	Parm5 is the WBAN number of the observation station	
Example:	SF **IN2** **TAPE** filename CD144FB ASCII 13840	

Keyword:	**IN2** used on pathway SF	
Purpose:	Define input disk file for NWS surface data	
Syntax:	Pathway **IN2** Parm1 Parm2 Parm3 Parm4	
Parm1:	Parm1 is always **DISK**	
Parm2:	Parm2 is the name of the disk file	
Parm3:	Parm3 is the disk file format:	**CD144FB** **SCRAMFB** **SAMSON**
Parm4:	Parm4 is the WBAN number of the observation station	
Example:	SF **IN2** **DISK** filename SCRAMFB 13840	

Table B-2 (continued)

Syntax for Keywords Used in Defining Files for Stage 1

Keyword:	**IN3** used on pathway SF
Purpose:	Define input disk file for NWS hourly precipitation data
Syntax:	Pathway **IN3** Parm1 Parm2 Parm3 Parm4
Parm1:	Parm1 is always **DISK**
Parm2:	Parm2 is the name of the disk file
Parm3:	Parm3 is the disk file format: **TD3240FB** **TD3240VB**
Parm4:	Parm4 is the six-digit station identifier recorded in columns 4-9 in each TD-3240 record. The station identifier includes a two-digit state code and a four-digit number assigned by NCDC.
Example:	SF **IN3** **DISK** filename TD3240FB 992415

Table B-3

Syntax for Keywords: AUD - VBL

Keyword:	**AUD** used on pathway UA, SF, and OS
Purpose:	Add variables to the audit summary report
Syntax:	Pathway **AUD** Parm1, Parm2, ...
Parm1:	Parm1, Parm2, ... are the 4-character variable names listed in Appendix C. The AUD input can be repeated as often as needed in order to list all the variables to be added to the audit summary. The default list of audit variables on the UA-pathway are the twice-daily mixing height values. The default list of audit variables on the SF-pathway are: wind direction, wind speed, ceiling height, sky cover, temperature, sea-level pressure, station pressure, and visibility. The default list of audit variables on the OS-pathway are: mixing height, wind direction, wind speed, ceiling height, sky cover, temperature, sea-level pressure, station pressure, σ_A, and σ_E.
Examples:	SF **AUD** PWTH OS **AUD** INSO DT01

Keyword:	**AVG** used on pathway OS
Purpose:	Define maximum number of observations per hour
Syntax:	Pathway **AVG** Parm1
Parm1:	Parm1 is the maximum number of on-site observations expected during an hour. The default value is 1. The maximum value allowed is 12.
Example:	OS **AVG** 4

Keyword: Purpose:	**CHK** used on pathway UA, SF, and OS Redefine quality assessment range check parameters
Syntax:	Pathway **CHK** Parm1 Parm2 Parm3 Parm4 Parm5
Parm1	Parm1 is the 4-character variable name (2-character for multi-level on-site variables) given in Appendix C.
Parm2	Parm2 is the range check switch (integer 1 or 2). 1 = exclude upper and lower bounds 2 = include upper and lower bounds
Parm3	Parm3 is the missing value indicator (flag), an integer variable.
Parm4	Parm4 is the lower bound for the range check (an integer).
Parm5	Parm5 is the upper bound for the range check (an integer).
Examples	OS **CHK** INSO 2 9999 0 700 OS **CHK** DT01 1 -999 -10 5 OS **CHK** SA 1 99 0 50

Keyword: Purpose:	**CLM** used only on pathway OS Define threshold for wind speed and wind direction
Syntax:	Pathway **CLM** Parm1
Parm1:	Parm1 is the threshold wind speed (ms^{-1}) for valid wind measurements (default = 1 ms^{-1}. The threshold wind speed is used in defining calms
Example:	OS **CLM** 0.5

Keyword: Purpose:	**DT1**, **DT2**, and **DT3** used only on pathway OS Define heights for vertical temperature difference measurements.
Syntax:	Pathway **DTn** Parm1 Parm2
Parm1:	Parm1 is the height (m) of the lower temperature measurement.
Parm2	Parm2 is the height (m) of the upper temperature measurement.
Example:	OS **DT1** 2 20

Keyword:	**END** used only on pathway JB
Purpose:	Signals end of input run stream for entire job
Syntax:	Pathway **END**
Parm1:	This keyword has no parameters
Example:	JB **END**

Keyword:	**EXT** used on pathway UA, SF, OS, MR, and MP
Purpose:	Define start and stop dates for processing
Syntax:	Pathway **EXT** Parm1 Parm2 Parm3 Parm4 Parm5 Parm6
Parm1:	Parm1, Parm2, and Parm3 define the starting year, month, and day of the data to be processed. Parm4, Parm5, and Parm6 define the ending year, month, and day of the data to be processed. The dates are inclusive (1.e., data for day "Parm3" will be included. All values must be entered as integers. Parm1 and Parm4 may be expressed fully (e.g., 1987) or abbreviated by the last two digits (e.g., 87).
Example:	UA **EXT** 94 10 31 94 12 01

Keyword:	**FIN** used on all pathways
Purpose:	Signifies end of input run stream for pathway
Syntax:	Pathway **KEY**
Parm1:	This keyword has no parameters
Example:	SF **FIN**

Keyword: Purpose:	**FMT** used only on Pathway OS Define FORTRAN formats for reading input data
Syntax: Parm1: Parm2 Examples:	Pathway **FMT** Parm1 Parm2 Parm1 is always **DATxx** where xx is an integer (i.e., 01, 02, etc.). DATxx - the xx refers to sequence number. For instance, if there are three READs (in the FORTRAN sense) needed for reading the data, then there would be DAT01, DAT02 and DAT03 definitions within the OS MAP input and there would likewise be DAT01, DAT02 and DAT03 definitions within the OS FMT input. Parm2 must be a valid Fortran format statement. The format must include the right and left parentheses. OS MAP DAT02 INSO TSKC CLHT OS **FMT** DAT02 (5X,F4.2,2X,2F5.2) Note the specification of the number of decimal places. This is not necessary for proper input of the value, but since we use this format in writing to the OQA-file, we NEED the decimal specification.

Keyword: Purpose:	**HGT** used only on Pathway OS Define heights associated with multilevel input data.
Syntax: Parm1: Parm2 Example:	Pathway **HGT** Parm1 Parm2 Parm3 ... ParmN Parm1 is the number of heights to be read in as input (Maximum: 10). Parm2 ... ParmN are heights of multilevel variables in meters. This image can not be repeated, so all values must be listed. OS **HGT** 5 2.0 4.0 10 30.0 50

Keyword:	**LOC** used on Pathways UA, SF and OS
Purpose:	Define location parameters for site.
Syntax:	Pathway **LOC** Parm1 Parm2 Parm3 Parm4
Parm1:	Parm1 is the site identification number. Typically, this is a 5-digit number. To avoid conflicts with current dispersion models expecting RAMMET type meteorological input, we suggest the OS pathway SiteID contain only numbers, no letters. Note, SiteID must agree with that given in the input data.
Parm2, 3	Parm2 and Parm3 are the longitude and latitude in decimal degrees. Longitude and latitude can appear in either position Parm2 or Parm3. The important point is to define both. North and south latitude are entered as 30.00N and 30.00S. Likewise, the longitude is entered as 170.13E. Note entering a latitude north of the Arctic (63.5 degrees N) where the sun does not rise during all or part of the winter will cause a run-time error in Stage 3 processing.
Parm4	Parm4 is the number of hours to be subtracted to convert times given on this pathway to Local Standard Time (LST). NWS upper air data are normally reported in Greenwich Mean Time. One should enter a value of 5 for Parm4 when processing such data for an East Coast location. Note, if times are given in LST, a zero must still be entered for Parm4.
Example:	UA **LOC** 03820 34.37N 81.97E 5

Keyword:	**LST** used only on Pathway JB
Purpose:	Turn on printed listing of generated meteorological data.
Syntax:	Pathway **LST**
Parm1:	This Keyword has no parameters.
Example:	MP **LST**

Keyword: Purpose:	**MAP** used only on Pathway OS Identify and define the order of variables in data records
Syntax:	Pathway **MAP** Parm1 Parm2 Parm3
Parm1:	Parm1 is of the form **DATxx** and defines the sequence for the input. The **xx** indicates the record number. The first record, DAT01, must begin with a date (year, month, and day) and time. The time must indicate the hour of day, minutes is optional. The order of the date and time variables is not important.
Parm2 ...	Parm2, Parm3, etc. are 4-character variable names for the OS variables to be processed. Variable names are given in Appendix C. The following restrictions apply: • Each observation must be completely labeled with a date and time, which at least defines the year, month, day and hour of the observation. • The date and time data must be entered as integers and must precede the data for all other variables. Note, the order of the date is not important; year, month and day is just as acceptable as day, month and year. • The following limitations apply: Observations are limited to 20 records per observations. Records are limited to 40 variables per record. Multi-level variables are limited to 10 levels.
Example:	The following input images describe a data set having three records per observation. The date and time of the observation are stored in the first record. Temperature, wind direction, and wind speed from two levels on a meteorological tower are stored in the second (tower level 01) and third records (tower level 02). There is no relationship assumed between the sequence number, xx, given in DATxx with the measurement level given in the multi-level variable name. OS MAP DAT01 OSYR OSMO OSDY OSHR OS MAP DAT02 TT01 WD01 WS01 OS MAP DAT03 TT02 WD02 WS02

Keyword:	**MET** used only on Pathway MP
Purpose:	Define diskfile of merged data.
Syntax:	Pathway **MET** Parm1 Parm2 Parm3
Parm1:	Parm1 is always **DISK**
Parm2	Parm2 is the filename.
Parm3	Parm3 is the integer number of hours needed to be subtracted from Greenwich Mean Time to convert to Local Standard Time.
Examples:	MP MET DISK [JSI.MPRM.DAT]RAMSTL.DAT 5 MP MET DISK RAMSTL.DAT 5

Keyword:	**MMP** used only on Pathway MP
Purpose:	Define dispersion model and diskfile name for output.
Syntax:	Pathway **MMP** Parm1 Parm2 Parm3
Parm1:	Parm1 is always **DISK**
Parm2	Parm2 is the filename
Parm3	Parm3 (optional) identifies the dispersion model. The default, if no model is specified, is ISCST. Valid selections are as follows: ISCST, ISCSTDRY, ISCSTWET, BLP, COMPLEX1, RAM, CALINE-3, RTDM, VALLEY, ISCLT, CDM16, and CDM36.
Examples:	MP MMP DISK [JSI.MPRM.DAT]RAMMET.DAT MP MMP DISK RAMMET.DAT CDM36

Keyword:	**OFF** used only on Pathway UA
Purpose:	Turn off automatic modification checks to upper air data
Syntax:	Pathway **OFF**
Parm1:	This keyword has no parameters.
Example:	UA **OFF**

Keyword:	**RUN** used only on Pathway JB
Purpose:	Inhibit data processing; check run stream syntax and stop
Syntax:	Pathway **RUN**
Parm1:	This keyword has no parameters
Example:	JB **RUN**

Keyword:	**SFC** on Pathway OS
Purpose:	Define surface characteristics of measurement site
Syntax:	OS **SFC** Parm1 Parm2 Parm3 ...
Parm1:	Parm1 is one of the following: **SETUP SECTORS VALUES**
Parm2	see the following

Keyword:	**SFC SETUP** on Pathway OS
Purpose:	Define frequency and number of direction sectors for surface characteristics
Syntax:	**SFC SETUP** Parm2 Parm3
Parm2:	Parm2 specifies the frequency for the surface characteristics and must be one of the following: **ANNUAL** characteristics are constant for entire year **SEASON** characteristics change as a function of season: Winter (December - February); Spring (March - May); Summer (June - August); Autumn (September - November **MONTHLY** characteristics change every calendar month
Parm3:	Parm3 is the number of non-overlapping wind direction sectors over which the surface characteristics vary; maximum of 12.
Example:	0S **SFC SETUP SEASON** 2

Keyword:	**SFC SECTORS on Pathway OS**
Purpose:	Define direction sectors for surface characteristics
Syntax:	OS **SFC SECTORS** Parm2 Parm3 Parm4
Parm2:	Parm2 is the sector index
Parm3:	Parm3 defines the beginning wind direction for the sector
Parm4:	Parm4 defines the ending wind direction for the sector
Example:	OS **SFC SECTORS** 1 0 180

Keyword:	**SFC VALUES** on Pathway OS
Purpose:	Specify values for surface characteristic
Syntax:	**OS SFC VALUES** Parm1 Parm2 ... Parm9
Parm1:	Parm1 is the frequency index (1 for annual, 1-4 for season, or 1-12 for monthly). Seasons are defined in MPRM as follows: Winter = December, January and February (parm1 = 1); Spring = March, April, and May (parm1 = 2); Summer = June, July, and August (parm1 = 3); Fall = September, October, and November (parm1 = 4).
Parm2:	Parm2 is the sector index (maximum value 12)
Parm3:	Parm3 is Noon-time albedo (default = .25)
Parm4:	Parm4 is Bowen ratio (default = 0.70)
Parm5:	Parm5 is surface roughness length (meters) at the site where meteorological data are collected (default = 0.15 m)
Parm6:	Parm6 is surface roughness length (meters) at the site where the output from Stage 3 are to be applied (default = 0.15 m)
Parm7:	Parm7 is minimum Monin-Obukhov length (meters) for stable conditions (default = 2.0 m)
Parm8	Parm8 is fraction of net radiation absorbed by the ground (default = 0.15)
Parm9	Parm9 is anthropogenic heat flux (default = 0.0 Wm^{-2})
Example:	OS **SFC VALUES** 1 1 0.25 0.70 0.15 0.15 2.00 0.15 0.00

Keyword:	**STA** used on Pathways JB, MP, UA, SF, OS AND MR
Purpose:	Signals beginning of input run stream data for pathway
Syntax:	Pathway **STA**
Parm1:	This keyword has no parameters
Example:	JB **STA**

Keyword: Purpose:	**TOP** used only on Pathway UA Purpose: Define 'clipping height' for upper air data
Syntax: Parm1: Example:	Pathway **TOP** Parm1 Parm1 is height in meters. Upper air data given for heights above ground greater than Parm1 are ignored. Note, value must be entered as an integer UA **TOP** 7500

Keyword: Purpose:	**TRA** as used on Pathway MP Purpose: Turn on trace notes to provide details of processing.
Syntax: Parm1: Example:	Pathway **TRA** This Keyword has no parameters MP **TRA**

Keyword: Purpose:	**TRA** as used on Pathways UA, SF and OS Purpose: Turn on trace for missing data during QA processing.
Syntax: Parm1: Example:	Pathway **TRA** Parm1, Parm2, ... Parm1, Parm2, ...are 4-character variable names as listed in Appendix C. SF **TRA** PWTH PRES CLHT TSKC WD16 WIND

Keyword: Purpose:	**VBL** used only on Pathway MP Purpose: Define methodology for processing meteorological variables
Syntax: Parm1: Parm2 Parm3 Examples:	Pathway **VBL** Parm1 Parm2 Parm3 Parm4 Parm1 is a 4-character string identifying the meteorological variable. Valid strings are: WIND, TEMP, MHGT, and STAB. Parm2 is a 6-character string specifying the processing methodology. See Table 3-3. Parm3 is the height (m) associated with the variable (normally the measurement height). MP VBL WIND ONSITE 35.0 MP VBL STAB SASITE 10.0

APPENDIX E

SUMMARY OF ERROR AND WARNING MESSAGES

During processing of the input images and the data, the processor writes messages to the error/message file defined in the JB ERR input image (see Appendix B for a description of this image). Five types of messages can be generated:

- An error that stops the processor from completing the original request for data processing; considered a fatal error
- An error that may not stop processing
- Status of the processing
- Quality assessment violation
- A computation could not be performed during Stage 3 processing AND the trace option is on.

A message from the processor has the form:

```
N PP a1a2a3 SSSSSS: message
 |  |     |     |      |
 |  |     |     |      └── More detailed description of the message
 |  |     |     |           code (up to 40 characters)
 |  |     |     |
 |  |     |     └── Subroutine from which the message is generated
 |  |     |
 |  |     └── Alphanumeric message code
 |  |
 |  └── Pathway ID (JB, UA, SF, OS, MR, MP)
 |
 └── Counter
```

The message code is composed of two parts - a leading alphabetic character and a trailing 2-digit code. The alphabetic character (a_1 above) can be:

E fatal error; if the error occurs during processing of input images, the remainder of the images are processed to locate other possible problems with the images; if the error occurs during processing of data on a pathway, processing ceases on that pathway and the next step defined by the input images begins

W warning; further data processing may or may not be prohibited depending on the processing requested through the input images;

I information on the status of the processing - these messages monitor the progress of a processor run;

Q quality assessment violation - a value for a variable was outside the interval defined by the upper and lower bounds;

T an hourly computation could not be performed during Stage 3 processing AND the hourly trace key was turned on using the input image MP TRA.

The 2-digit codes (a_2a_3 in the message code) are grouped into general categories corresponding to the processing in Stages 1, 2, and 3. These categories are

00-19	Input image processing
20-29	File header and library processing
30-39	Upper air soundings and mixing heights processing
40-49	Surface observations processing
50-59	On-site observations processing
60-69	Merge processing
70-79	Stage 3 processing
**	program trap - there is an error in program logic; the processor stops immediately

Within the general categories are codes pertaining to processing in MPRM. These codes are more specific than the general categories but do not completely specify the reason for the message. That is left to the 40-character message. The codes are summarized by pathway and severity and category at the end of each processor run in a table that is written to the file defined by the JB OUT input image or, if this image is omitted, the default output device. The MPRM processor uses device number (logical unit) 6 for this purpose.

Input Image Errors and Messages: 00 - 19

If an error is detected on an input image, a message is written to the message file and any attempt to process data is prohibited. If a warning occurs, data may or may not be processed, depending on the processing requirements specified within the run stream input data. For example, a warning with a message code of W12 is written if there is no IQA image on a pathway. If it is detected that the user wants to extract data, processing will be halted as there is not output file (defined by use of the IQA input) for the extracted data.

E00 A keyword field is blank

E01 Repeated keyword/Improper keyword

E02 Error reading an input image
E03 Error decoding a field on an input image

E04 Incomplete or superfluous information on an input image

E05 Error in a field - a keyword could not be determined

E06 A value or character is not within bounds or is unreasonable; improper information specified in a field; no match with allowable names (see also code W06 below)

E07 Error opening a tape or file; file not open; the file name was specified for more than one device (logical unit) number

E10 Fatal write error to the temporary file

E11 Pathway status (status = -1) does not allow further processing

E12 Unable to proceed; previous errors on a pathway card (from subroutine COMPLETE)

E13 The on-site data map and formats were not specified

E14 An attempt was made to change a previously established value for Stage 3 processing

W00 A blank image was encountered in the input images

W06 Value on an input card image may not be reasonable (see also code E06 above)

W10 Non-fatal write error writing to the temporary file

W12 Missing/errors on an input image - may or may not be fatal depending on the processing requested

W15 Audit disabled for the on-site variable specified

I10 No extraction on the pathway specified

I11 No quality assessment on the pathway specified

I12 No file on the pathway specified to merge

I19 End-of-file or JB END card encountered

File Header and Library Errors and Messages: 20 - 29

Any messages that pertain to writing file headers during the initial processing or messages issued by the library routines (those routines accessed by more than one subroutine) are in this category.

E20 Header read error

E21 Header write error

E22 From subroutine FLHEAD: there were errors on the input file, so there are no data to process

E23 From subroutine FLHEAD: error reading the headers placed in the output file by input image processing

E24 From subroutines CHROND or ICHRND: The E24 error indicates a problem in computing the chronological day. The data filename as specified in the input image may be incorrect; as a result, MPRM is attempting to read the wrong file. Also, extraneous data may be imbedded in the file. For example, header and/or footer records are sometimes included to document data files; such header/footer records may need to be removed prior to processing.

W22 From subroutine FLHEAD: An end-of-file was encountered reading the headers on an input file, there is no processing of data from this pathway

I23 From subroutine FLHEAD: an end-of-file reading the headers from the output file - a correct condition

Upper Air Processing Errors and Messages: 30 - 39

Any messages that pertain to the upper air pathway, and issued after the input images are processed, are in this category.

E32 There is an error reading or decoding the data and the count now exceeds the maximum number of errors allowed

E35 Data blocking type specified incorrectly - allowable specifications are VB (variable block) and FB (fixed block)

E36 Error reading the file headers during quality assessment - no data processed

W32 There is an error reading or decoding the data and the count is less than the maximum number allowed - processing continues

W33 Sounding surface height is less than zero; the height is set to zero

W38 No soundings or mixing heights were retrieved because there was no match found in the data with the station ID specified in the run stream input.

I30 A message indicating that the point has been reached where processing of the UA-data can begin

I31 Automatic data modification for upper air soundings is enabled (see section 6 for a discussion of these modifications)

I32 No data were extracted; a report of the tape/file contents is written to the error/message file

I37 A mixing height quality assessment lower bound violation; this message code is written for the second and subsequent encounters of the mixing heights within a day

I38 A mixing height quality assessment upper bound violation; this message code is written for the second and subsequent encounters of the mixing heights within a day

I39 An end-of-file was encountered on the input file in the expected position in the file

Q34 The vertical gradients cannot be computed at one or more heights because one or more heights are missing

Q35 The sounding height is not in any of the height intervals defined for the upper air audit; the processor STOPS immediately and the last message in the message file will identify the location of the problem; neither a summary table nor an audit table is generated

Q36 From subroutine HTCALC: the heights have not been recomputed due to missing data

Q37 A lower bound quality assessment violation

Q38 An upper bound quality assessment violation

Surface Processing Errors and Messages: 40 - 49

Any messages that pertain to the surface pathway, and issued after the input images are processed, are in this category.

E42 There is an error reading or decoding the data and the count now exceeds the maximum number of errors allowed

E46 Error reading the file headers during quality assessment - no data processed

W42 There is an error reading or decoding the data and the count is less than the maximum number allowed - processing continues

W43 Possible error decoding an over-punch character. The W43 error flag may sometimes occur when MPRM attempts to decode a cloud type field (e.g., column 58 in a CD-144 file); valid cloud type codes are 'K', 'M', 'N', 'O', and 'R'. In such cases, there is no error - the W43 warning may be disregarded.

W48 No surface observations were retrieved because there was no match found in the data with the station ID specified in the run stream input.

I40 A message indicating that the point has been reached that processing of the SF-data can begin

I48 No data were extracted; a report of the tape/file contents is written to the error/message file

I49 An end-of-file was encountered on the input file in the expected position in the file

Q47 A lower bound quality assessment violation

Q48 An upper bound quality assessment violation

On-site Processing Errors and Messages: 50 - 59

Any messages that pertain to the on-site pathway, and issued after the input images are processed, are in this category.

E50 There is an error reading an input file header

E51 There is an error writing an input file header to the output file

E52 There is an error reading or decoding the data and the count now exceeds the maximum number of errors allowed

E53 There is an error writing data to the output file

E54 The observations are not sequential in time

E55 The number of observations exceeds the number expected for the hour, defined as 1 (default) or on the input image OS AVG (note maximum of 12 allowed)

E56 An end-of-file on the input data was encountered before one complete observation was read

W52 There is an error reading the data and the count is less than the maximum number allowed - processing continues

I57 An intra-hour observation violated a quality assessment lower bound

I58 An intra-hour observation violated a quality assessment upper bound

I59 An end-of-file was encountered on the input file in the expected position in the file

Q57 Lower bound quality assessment violation

Q58 Upper bound quality assessment violation

Merge Errors and Messages: 60 - 69

Any messages pertaining to combining the three data types (merge), and issued after the input images are processed, are in this category.

E60 There is an error computing the chronological day from Julian day and year

E61 There is an error computing the Julian day and year from the chronological day

E62 There is an error reading the upper air data

E63 There is an error reading the surface data

E64 There is an error reading the on-site data

E65 There is an error writing the on-site data to the output file

E66 There is an error processing an input file's header cards

E67 No chronological days for merging were computed

I67 The beginning chronological day is computed from the earliest available date on the three pathways; the ending chronological day = beginning day + 367. This message is generated if no MR EXT input is defined.

Stage 3 Errors and Messages: 70 - 79

Any messages that pertain to Stage 3 processing, and issued after the input images are processed, are in this category.

E70 The preliminary processing (such as the latitude and longitude) has produced an error; the input file has no data; the 40-character message further identifies the source of the error

E71 There is an error reading the input data; the data are not a 1 - 24 hour clock; the hour for on-site data is represented by the missing value indicator

W70 During preliminary processing, a value does not appear correct (e.g., the GMT to LST conversion factor); hour 23 data have been swapped in for hour 24 data for the surface pathway

W72 The mixing heights were not computed for the specified number of hours

W73 The temperatures cannot be determined for the specified number of hours

W74 The winds cannot be determined for the specified number of hours

W75 The stability categories cannot be determined for the specified number of hours

W76 The surface roughness length cannot be determined for the number of hours specified

I70 End of header group reached on input file

I71 Station location for pathway changed from characters to 0 (zero) to conform to RAMMET output specifications

I75 Missing data has resulted in use of an alternate estimation scheme for stability, the alternate scheme is reported in message

I79 The end of the processing window, defined by the JB EXT image, was encountered or, if no window was specified, the end-of-file was encountered

Trace Image Messages T72 - T76

The following are written only if the JB TRA image is present for Stage 3 processing:

T72 The mixing height cannot be computed for the specified hour

T73 The temperature cannot be determined for the specified hour

T74 The winds cannot be determined for the specified hour

T75 The stability category cannot be computed for the specified hour and methodology

T76 The surface roughness length cannot be determined for the specified hour

APPENDIX F
FORMATS OF DATA FILES

This appendix describes the formats of: 1) unprocessed (raw) meteorological data files; 2) intermediate quality assured data files; and 3) processed data files for use in dispersion modeling.

Unprocessed (Raw) Data Files

The unprocessed data files include the following:

TD-5600	Unprocessed upper air data (NCDC Tape Deck)
TD-9689	NCDC estimated mixing heights (NCDC Tape Deck)
	NCDC estimated mixing heights (SCRAM disk file)
CD-144	NWS surface data (80 column format)
SCRAM	NWS surface data (compressed format)
SAMSON	NWS surface data
TD-3240	NWS hourly precipitation data

Table F-1

Tape Deck TD-5600 Format

Tape Positions			
Variable	Standard	Element	Description
01-04		Block Length	Number of bytes in this physical record - in binary. This occurs once each block
05-08		Observation Length	Number of bytes in this logical record - in binary. This field occurs at the beginning of each observation.
09-12	01-04	Deck Number	Unique for each type or source of data.
13-17	05-09	Station Number	WBAN number or ship number
18-19	10-11	Year	78 = 1978 etc.
20-21	12-13	Month	01 = Jan., ... 12 = Dec.
22-23	14-15	Day	Day of month: 01- 31
24-25	16-17	Hour	GMT: 01- 23
26-27	18-19	Number of Levels	Number of 25 character levels contained in this observation.
28-33	20-25	Blank or ship position	Blank for land stations.
34-38	26-30	Pressure	Pressure in millibars and tenths.
39-43	31-35	Height	Height of the level, above sea level, in geopotential meters. Signed plus = HGT above sea level *Signed minus = HGT below sea level
44-46	36-38	Temperature	Temperature of the level in degrees celsius and tenths. Signed plus = Positive temperature *Signed minus = Negative temperature
47-49	39-41	Relative Humidity	Relative humidity of the level in whole percent. Signed plus = Actual RH *Signed minus = Estimated RH
50-52	42-44	Wind Direction	Wind direction of the level in whole degrees
53-55	45-47	Wind Speed	Wind speed of the level in meters per second.
56-57	48-49	Blank	
58	50	Level Type Indicator	Blank = blank 1 = Surface 2 = First Tropopause level 4 = Mandatory or significant level 8 = Generated level 0 = All others

Each data level is 25 bytes. Missing data fields are coded as all 9's (with signed fields being signed minus in recent years). The first level is always the surface. All other levels then follow in decreasing pressure (ascending height).

Variable - Observations are packed as many as possible into variable length blocks that do not exceed 6000 bytes.

Standard - Format allows for up to 79 levels, including the surface of 25 positions each. Blanks are filled in following the last reported level making each observation 200 character positions in length.

If observations contain more than 79 levels, the observation should continue in the next record and the number of levels (tape position 18-19) would be coded 90-99, i.e., 90 and 91 = level 80 and 81. etc.

* Right most position of these fields may contain the characters A-I = Positive 1 through 9 and J-R = Negative 1 through 9. A positive or negative 0 in this position may appear as a special character or a non-printable character.

Table F-2

Tape Deck TD-9689 Format

Column	Element
1-5	NWS Station ID
6-7	Year
8-9	Month
10-11	Day of month
12	AM precipitation type: 1 = none 2 = 3 = 4 = missing
13	blank
14-17	AM mixing height (meters)
18-21	Average wind speed through mixing depth (m/s)
22-25	Surface wind speed (m/s)
30	PM precipitation type
32-35	PM mixing height (meters)
36-39	Average wind speed through mixing depth (m/s)
40-43	Surface wind speed (m/s)

Table F-3

SCRAM Mixing Height Format

Column	Element
1-5	NWS Station ID
6-7	Year
8-9	Month
10-11	Day of month
14-17	AM mixing height (meters)
32-35	PM mixing height (meters)

Table F-4

Card Deck CD-144 Format

Column	Element
1-5	NWS Station ID
6-7	Year
8-9	Month
10-11	Day of month
12-13	Hour (00 to 23)
14-16	Ceiling height (hundreds of feet)
24-29	Present weather
24	Thunder storms
25-26	Liquid precipitation
27-29	Frozen precipitation
32-35	Sea level pressure (mb and tenths)
39-40	Wind direction (tens of degrees)
41-42	Wind speed (knots)
43-46	Station Pressure (hundredths of inches)
47-49	Dry bulb temperature (degrees F)
53-55	Relative humidity (percent)
56	Total cloud cover (tenths)
79	Total opaque cloud cover (tenths)

Table F-5

SCRAM Surface Format

Column	Element
1-5	NWS Station ID
6-7	Year
8-9	Month
10-11	Day of month
12-13	Hour (00 to 23)
14-16	Ceiling height (hundreds of feet)
17-18	Wind direction (tens of degrees)
19-21	Wind speed (knots)
22-24	Dry bulb temperature (degrees F)
25-26	Total cloud cover (tenths)
27-28	Total opaque cloud cover (tenths)

SAMSON Data

SAMSON data consist of hourly surface observations archived on the Solar and Meteorological Surface Observation Network (SAMSON) CD-ROM. These data are available for 'first order' stations for the 30-year period 1961-1990; the data reside on a set of three CD-ROMs.

In order to use the SAMSON data (MPRM does not access the SAMSON data directly) one runs the extraction software provided with the CD-ROM. The SAMSON software is DOS-based with an interactive user-friendly graphical interface. Output is written to an ASCII file. If directed by the user, multiple years of data can be extracted and saved to a file. However, one needs to be aware that MPRM does not expect multiple years of data. If more than one year of data is provided to MPRM, an error is reported and processing is terminated.

Retrieving data from the CD-ROM is completely under the control of the user. The user specifies which variables to retrieve from a list of 21 variables stored for each station. To be compatible with the data in the meteorological files on SCRAM, the ceiling height, wind direction, wind speed, dry bulb temperature and opaque cloud cover should be retrieved. These variables are sufficient for most of the models that MPRM supports, and results in an ASCII file of about 400 Kb for one year of meteorological data. If dry and/or wet deposition estimates are to be made, then several additional variables are needed. These are: station pressure for dry deposition (resulting in a file size of about 445 Kb), and present weather and hourly precipitation for wet deposition (resulting in a file size of about 537 Kb). If all 21 variables are retrieved, then a file size of about 1.2 Mb is created. When precipitation data are retrieved, the size will vary because precipitation amount is the last field and is filled only if there was precipitation for the hour, making some records longer than others.

When the data are retrieved from the CD-ROM, two records are written at the beginning of the file that identify the station (first record) and the variables retrieved (second record). MPRM processes both of these records to obtain information about the station (e.g., latitude and longitude) and to determine how to process the data that follow. *It is imperative that the user not alter or delete these records.* The two initial records, or headers, begin with the tilde character (~). If more than one year of data are retrieved from the CD-ROM, then two records beginning with the tilde appear before each year in the file. When the second set of headers is encountered, MPRM will print a warning in the message file and terminate normally. MPRM expects an integer value (the year), but encounters a character value (the tilde), causing the error. However, the output for the first year will be complete and intact. *It is recommended that the user restrict data retrieved from CD-ROM to one station and one year per file.*

The header records are followed by the data records (one record per hour). Note that SAMSON uses a 01 - 24 hour clock for labeling records. Thus, unlike the CD-144 format which uses a 00 - 23 clock, there is no need to adjust time labels at the beginning/end of the day.

Data stored in the SAMSON format are in different units than the units in the CD-144 data, which are the units as recorded by the National Weather Service. MPRM converts the SAMSON data to the units of the CD-144 data as part of the data processing.

The first record in the file retrieved from a SAMSON CD-ROM is a header record providing the station name, location, etc. The format of this record is provided in Table F-6.

The second record contains the list of variables (by position number) that appear in the data file. Each variable is represented by a position number. This position number always corresponds to that variable, no matter how many or how few variables are retrieved. There is no particular format; the variable number appears above the column of data it represents with at least one space (and usually many more) between the position numbers.

The third and subsequent records contain the weather elements retrieved from the SAMSON CD-ROMs. The data are free format, i.e., there is at least one space between each element in the record. The year, month, day, hour and observation indicator always appear on each record. These are followed by the variables retrieved by the user. If all the variables were retrieved, they would appear in the order shown in Table F-7.

An online help feature is provided with the SAMSON CD-ROM data base. The online help provides additional information on the variables, such as missing value indicators, etc.

Table F-6

Contents of the First Header Record in a SAMSON File

Field	Description	Columns
01	~ to indicate a header record	001
02	WBAN station number identifier	002-006
03	City where station is located	008-029
04	State where station is located	031-032
05	The number of hours by which the local standard time lags or leads Universal Time.	033-036
06	Station latitude	
	N = north, S = south	039
	Degrees	040-041
	Minutes	043-044
07	Station longitude	
	W = west, E = east	047
	Degrees	048-050
	Minutes	052-053
08	Elevation of the station in meters above sea level	056-059

Table F-7

Order of Variables in a SAMSON File

Variable #	Description	Units
	Year, month, day, hour (LST), indicator	--
1	Extraterrestrial horizontal radiation	W m^{-2}
2	Extraterrestrial direct normal radiation	W m^{-2}
3	Global horizontal radiation	W m^{-2}
4	Direct normal radiation	W m^{-2}
5	Diffuse horizontal radiation	W m^{-2}
6	Total cloud cover	tenths
7	Opaque cloud cover	tenths
8	Dry bulb temperature	°C
9	Dew point temperature	°C
10	Relative humidity	percent
11	Station pressure	millibars
12	Wind direction	degrees
13	Wind speed	m s^{-1}
14	Visibility	kilometers
15	Ceiling height	meters
16	Present weather	--
17	Precipitable water	millimeters
18	Broadband aerosol optical depth	--
19	Snow depth	centimeters
20	Days since last snowfall	--
21	Hourly precipitation (may include a flag)	inches and hundredths

TD-3240 Precipitation Data

The TD-3240 precipitation data file is needed for wet deposition modeling if one is obtaining surface data from a CD-144 file. The precipitation type is obtained from the present weather fields in the hourly surface observation file (CD-144 or SAMSON) and Stage 3 converts the code to a precipitation code that ISCST can interpret. The precipitation rate is obtained from the TD-3240 file. The TD-3240 data can also be used to supplement the SAMSON precipitation data in the event there are little or no precipitation data for a station (there are about 20 such stations which are noted in the SAMSON online help), or if precipitation was not retrieved from the CD-ROM.

MPRM processes two precipitation formats: TD3240VB and TD3240FB. These formats identify the TD-3240 precipitation data as either variable (VB) or fixed (FB) length blocks, respectively. Precipitation data in a variable-length format are stored for an entire day on one record, and only for those hours during which precipitation was reported. A fixed-length format is also available in which one record contains the precipitation amount for one hour. As with variable-length files, data are reported only for those days and hours for which precipitation occurred. For variable-length formats, the preprocessor converts the data to a fixed-length format, writes the result to a scratch file and uses the scratch file for processing. The scratch file is deleted at the end of the run. Precipitation is reported in inches and hundredths of an inch in the TD-3240 format. These units are converted to millimeters for use in the ISCST dispersion model. The format of the precipitation data for variable-length blocks is shown in Table F-8. The Station-id is a unique identifier assigned by NCDC and is a concatenation of a state code (the first two digits) ranging from 01 to 48, and 66, 67, and 91, and a cooperative network index (the last 4 digits) ranging from 0001 to 9999. It is not the WBAN number used to identify a station in the CD-144, SCRAM and SAMSON formats.

Data groups in the same form as fields 009-012 are repeated as many times as necessary such that the hours for which precipitation occurred for one day appear on one record. The remaining data would begin in field 013 and extend through field 104 if precipitation occurred for all hours of the day. The final four fields on each record consists of the accumulated amount, including zero precipitation, for the day.

Fixed-length blocks contain a stations's precipitation record for one hour on a physical record. The structure is identical to the variable-length blocks, except that only one hour of data appears on the record; i.e., fields 001 through 012. The final record for each day consists of the accumulation record.

The National Climatic Data Center publication *TD-3240 Hourly Precipitation* (NCDC, 1990) contains a complete discussion of the format, definitions and remarks for each of the fields presented above, including special flags that appear in field 011. The conversion between precipitation type and intensity and precipitation code is given in Table 4-9.

Table F-8

Format of Variable-Length TD-3240 Precipitation Data Record

Field	Description	Columns
01	Record type	001-003
02	Station identifier	004-011
03	Meteorological element type	012-015
04	Measurement units	016-017
05	Year	018-021
06	Month	022-023
07	Day (right justified, zero filled)	024-027
08	Number of data groups to follow	028-030
09	Hour (left justified, zero filled)	031-034
10	Value of meteorological element	035-040
11	Measurement flag #1	041
12	Quality flag #2 (not used, blank)	042

Table F-9

Conversion of Reported Precipitation Type/Intensity to Precipitation Code

Precipitation Code	Type	Intensity
1	Rain	Light
2	Rain	Moderate
3	Rain	Heavy
4	Rain Showers	Light
5	Rain Showers	Moderate
6	Rain Showers	Heavy
7	Freezing Rain	Light
8	Freezing Rain	Moderate
9	Freezing Rain	Heavy
10	(not used)	-
11	(not used)	-
12	(not used)	-
13	Drizzle	Light
14	Drizzle	Moderate
15	Drizzle	Heavy
16	Freezing Drizzle	Light
17	Freezing Drizzle	Moderate
18	Freezing Drizzle	Heavy
19	Snow	Light
20	Snow	Moderate
21	Snow	Heavy
22	Snow Pellets	Light
23	Snow Pellets	Moderate
24	Snow Pellets	Heavy
25	(not used)	-
26	Ice Crystals	*
27	(not used)	-

28	Snow Showers	Light
29	Snow Showers	Moderate
30	Snow Showers	Heavy
31	(not used)	-
32	(not used)	-
33	(not used)	-
34	Snow Grains	Light
35	Snow Grains	Moderate
36	Snow Grains	Heavy
37	Ice Pellets	Light
38	Ice Pellets	Moderate
39	Ice Pellets	Heavy
40	(not used)	-
41	Hail	*
42	(not used)	-
43	(not used)	-
44	Small Hail	*
45	(not used)	-

* Intensity not reported for ice crystals, hail and small hail.

Intermediate MPRM Data Files

The upper air and surface observations are written in a specific format after the data are extracted. These formats are retained until the data are merged in Stage 2. This discussion does not apply to on-site data which are under the control of the user (i.e., the user specifies the order and format for the data).

Upper Air Data

An extracted upper air data file is composed of two parts:

- A header record consisting of a year, month, day, hour group, the number of sounding levels, and the morning and evening mixing heights. The format of the header record is provided in Table F-10.

- Sounding data, if soundings were extracted, consisting of a pressure, height above ground level, temperature, dew-point temperature, wind speed, and wind direction. The format of this record is provided in Table F-11.

All values on the upper air pathway are written as integers. The 4-character names used to identify the variables are listed in Appendix C along with the default parameters.

Table F-10

Format of Header Record for Upper Air Data

Field	Element/Description	Format	Column(s)
1	Year	I2	2-3
2	Month	I2	4-5
3	Day of month	I2	6-7
4	Hour of the observation in Local Standard Time (LST). Set to 12 if only mixing height data are extracted.	I2	8-9
5	Number of sounding levels in this report (0 if no soundings were extracted.	I5	10-14
6	AM mixing height (meters)	I5	16-20
7	PM mixing height (meters)	I5	22-26

Table F-11

Format of Upper Air Data Records

Field	Element/Description	Format	Column(s)
1	**UAPR -** Atmospheric Pressure (millibars)*	I5	2-6
2	**UAHT -** Height above ground level (agl) (meters)	I5	8-12
3	**UATT -** Dry bulb temperature (°C)*	I5	14-18
4	**UATD -** Dew point temperature (°C)*	I5	20-24
5	**UAWD -** Wind direction (tens of degrees from north)	I5	26-30
6	**UAWS -** Wind speed (m/s)*	I5	32-36

* Values are multiplied by 10 to retain one significant digit after the decimal point prior to rounding the result to the nearest whole number.

Surface Data

NWS surface data processed by MPRM are stored in two files: 1) a file defined using the **IQA** keyword which contains the extracted data; and 2) a file defined by the **OQA** keyword which contains the quality assured data. The two files are identical. Each hourly surface observation processed by MPRM consists of two records formatted as shown in Tables F-12a and F-12b. As with the upper air data, all values are reported as integers with several variables being multiplied by 10 or 100 to retain significant digits; in addition, several of the variables are two variables combined (concatenated) to form one integer value. See Table C-1 for a list of the variables and the applicable multipliers, etc.

Table F-12a

First Record of Stage 1 Output for the SF Pathway

Variable	Format	Columns
Year (2-digits)	I2	02-03
Month	I2	04-05
Day	I2	06-07
Hour	I2	08-09
Altimeter pressure (mb)	I5	11-15
Sea level pressure (mb)	I5	17-21
Station pressure (mb)	I5	23-27
Ceiling height (km)	I5	29-33
Total//opaque sky cover (tenths)	I5	35-39
2nd//3rd layer sky cover (tenths)	I5	41-45
Layer 1 sky//coverage (tenths)	I5	47-51
Layer 2 sky//coverage (tenths)	I5	53-57
Layer 3 sky//coverage (tenths)	I5	59-63
Layer 4 sky//coverage (tenths)	I5	65-69

Table F-12b

Second Record of the Stage 1 output for the SF Pathway

Variable	Format	Columns
Layer 1 cloud type//height (km)	I5	10-14
Layer 2 cloud type//height (km)	I5	16-20
Layer 3 cloud type//height (km)	I5	22-26
Layer 4 cloud type//height (km)	I5	28-32
Present weather (2 types)	I5	34-38
Horizontal visibility (km)	I5	40-44
Dry bulb temperature (°C)	I5	46-50
Wet bulb temperature (°C)	I5	52-56
Dew point temperature (°C)	I5	58-62
Relative humidity (percent)	I5	64-68
Wind direction (degrees)	I5	70-74
Wind speed (m/s)	I5	76-80
Precipitation amount (mm)	I5	82-86

All reports of sky conditions, cloud types and present weather are converted to the TD-3280 numeric codes. These conversions are performed automatically as a part of the extraction process on the SF-pathway. The codes used for reporting sky condition are given in Table F-13.

Table F-13

Sky Condition Codes

TD-3280 Code	CD-144 Code	Description and coverage
00	0	clear or less than 0.1
01	1	thin scattered 0.1 to 0.5
02	2	scattered 0.1 to 0.5
03	4	thin broken 0.6 to 0.9
04	5	broken 0.6 to 0.9
05	7	thin overcast 1.0
06	8	overcast 1.0
07	X or -	obscuration 1.0
08	blank	partial obscuration < 1.0
09	blank	unknown

The codes used for reporting obscuring phenomena and aloud type are given in Table F-14. If no code is listed then there is no corresponding code in the CD-144 format. Overpunch characters in the CD-144 format are represented by X/n where n is an integer. An overpunch character as it appears in an ASCII file is also shown.

Table F-14

Obscuring Phenomena and Cloud Type Codes

Obscuring Phenomena	TD-3280 Code	CD-144 Code	Cloud Type	TD-3280 Code	CD-144 Code
blowing spray	01		none	00	0
smoke and haze	03		cumulus	11	4
smoke	04		towering cumulus	12	
haze	05		stratus fractus	13	X/2 or K
dust	06		stratus cumulus lenticular	14	
blowing dust	07		stratus cumulus	15	3
blowing sand	30		stratus	16	2
blowing snow	36		cumulus fractus	17	X/4 or M
ground fog	44		cumulonimbus	18	5
fog	45		cumulonimbus mammatus	19	X/5 or N
ice fog	48		altostratus	21	6
drizzle	50		nimbostrats	22	X/6 or O
rain	60		altocumulus	23	7
snow	70		altocumulus lenticular	24	
ice crystals	76		altocumulus castellanus	28	X/7 or P
other than fog	98	X or -	altocumulus mammatus	29	
			cirrus	32	8
			cirrocumulus lenticular	35	
			cirrostratus	37	9
			cirrocumulus	39	X/9 or R

The code definitions for present weather conditions are given in Table F-15. Dashes in a field indicate that there is no definition for that code. The 8-digit CD-144 format weather conditions are converted to the 2-digit TD-3280 category.

Table F-15

Present Weather Codes

Present Weather Description	TD-3280 Code
Thunderstorm - lighting and thunder	10
Severe thunderstorm - frequent intense lighting and thunder	11
Report of tornado or water spout	12
Light squall	13
Moderate squall	14
Heavy squall	15
Water spout	16
Funnel cloud	17
Tornado	18
Unknown	19
Light rain	20
Moderate rain	21
Heavy rain	22
Light rain showers	23
Moderate rain showers	24
Heavy rain showers	25
Light freezing rain	26
Moderate freezing rain	27
Heavy freezing rain	28
Unknown	29
Light rain squalls	30
Moderate rain squalls	31
Heavy rain squalls	32
Light drizzle	33
Moderate drizzle	34
Heavy drizzle	35
Light freezing drizzle	36
Moderate freezing drizzle	37
Heavy freezing drizzle	38
Unknown	39

Light snow Moderate snow Heavy snow Light snow pellets Moderate snow pellets Heavy snow pellets Light snow crystals Moderate snow crystals Heavy snow crystals Unknown	40 41 42 43 44 45 46 47 48 49
Light snow showers Moderate snow showers Heavy snow showers Light snow squalls Moderate snow squalls Heavy snow squalls Light snow grains Moderate snow grains Heavy snow grains Unknown	50 51 52 53 54 55 56 57 58 59
Light ice pellet showers Moderate ice pellet showers Heavy ice pellet showers Light hail Moderate hail Heavy hail Light small hail Moderate small hail Heavy small hail Unknown	60 61 62 63 64 65 66 67 68 69
Fog Ice fog Ground Fog Blowing dust Blowing sand Heavy fog Glaze Heavy ice fog Heavy ground fog Unknown	70 71 72 73 74 75 76 77 78 79

Smoke Haze Smoke and haze Dust Blowing snow Blowing spray Dust storm -- -- Unknown	80 81 82 83 84 85 86 87 88 89
Light ice pellets Moderate ice pellets Heavy ice pellets -- -- -- -- -- -- Unknown	90 91 92 93 94 95 96 97 98 99

Model Output Files

ISCST

The meteorological input required to run ISCST depends on the application and options employed. Basically, there are three options which determine the meteorological variables needed to run the model. The modeling options available with ISCST include concentration (with and without plume depletion), dry deposition, and wet deposition. Minimum requirements, common to all options, are wind direction, wind speed, temperature, stability class, and mixing height. The minimum requirements apply when one is modeling concentration without deposition or plume depletion; the MPRM output format for this option is described in Table F-17. Additional variables are needed if one is modeling dry deposition and/or dry depletion; the MPRM output for dry deposition/depletion estimates is described in Table F-18. Finally, precipitation data are needed if one is modeling wet deposition and/or depletion; the MPRM output for wet deposition/depletion is described in Table F-19. The data records for all three options are preceded by an identical header record described in Table F-16.

Table F-16

First Record of Output Files for ISCST, ISCSTDRY, and ISCSTWET

Field	Description	Format	Columns
01	Surface Station Number	I6	01-06
02	Surface Station Year	I6	08-13
03	Mixing Height Station Number	I6	15-20
04	Mixing Height Station Year	I6	22-27

Table F-17

Output File Format for ISCST

Field	Description	Format	Columns
01	Year (2 digits)	I2	01-02
02	Month	I2	03-04
03	Day	I2	05-06
04	Hour	I2	07-08
05	Randomized flow vector	F9.4	09-17
06	Wind speed (m/s)	F9.4	18-26
07	Ambient temperature (kelvin)	F6.1	27-32
08	Stability category	I2	33-34
09	Rural mixing height (m)	F7.1	35-41
10	Urban mixing height (m)	F7.1	42-48

Table F-18

Output File Format for ISCSTDRY

Field	Description	Format	Columns
01	Year (2 digits)	I2	01-02
02	Month	I2	03-04
03	Day	I2	05-06
04	Hour	I2	07-08
05	Randomized flow vector	F9.4	09-17
06	Wind speed (m/s)	F9.4	18-26
07	Ambient temperature (kelvin)	F6.1	27-32
08	Stability category	I2	33-34
09	Rural mixing height (m)	F7.1	35-41
10	Urban mixing height (m)	F7.1	42-48
11	Surface friction velocity, application site (m/s)	F9.4	49-57
12	Monin-Obukhov length, application site (m)	F10.1	58-67
13	Surface roughness length, application site (m)	F8.4	68-75

Table F-19

Output File Format for ISCSTWET

Field	Description	Format	Columns
01	Year (2 digits)	I2	01-02
02	Month	I2	03-04
03	Day	I2	05-06
04	Hour	I2	07-08
05	Randomized flow vector	F9.4	09-17
06	Wind speed (m/s)	F9.4	18-26
07	Ambient temperature (kelvin)	F6.1	27-32
08	Stability category	I2	33-34
09	Rural mixing height (m)	F7.1	35-41
10	Urban mixing height (m)	F7.1	42-48
11	Surface friction velocity, application site (m/s)	F9.4	49-57
12	Monin-Obukhov length, application site (m)	F10.1	58-67
13	Surface roughness length, application site (m)	F8.4	68-75
14	Precipitation code (0 for none, 1-18 for liquid, 19 and above for frozen)	I4	76-79
15	Precipitation amount (mm)	F7.2	80-86

BLP, COMPLEX1, RAM

This format accommodates several dispersion models: BLP, RAM, ISCST, and COMPLEX1. The file contains two types of records, the first is a header record and the second is the meteorological data. The second contains the data for one 24-hour period (midnight to midnight) and is repeated until all data are listed. The data are written unformatted to the file. The header and data records are described in Tables F-20 and F-21 respectively.

Table F-20

Header Record for the RAMMET Binary File

Field	Element/Description
1	5-digit NWS station identifier for surface data
2	Last 2 digits of beginning year for surface data
3	5-digit NWS station identifier for mixing height data
4	Last 2 digits of beginning year for mixing height data

Table F-21

Data Record for the RAMMET Binary File

Field	Element/Description	Missing Value
1	**IYEAR -** Last 2 digits of year	
2	**MONTH -** Month (1-12)	
3	**DAY -** Day of month (1-31)	
4	**PGSTAB -** Array of P-G stability categories	0
5	**SPEED -** Array of wind speeds (m/s)	-9
6	**TEMP -** Array of temperatures (K)	-99
7	**FLWVEC -** Array of flow vectors (nearest 10 degrees)	-99
8	**RANFLW -** Array of randomized flow vectors (nearest degree)	-99
9	**MIXHGT -** Array of urban and rural mixing heights (m)	-999

CALINE-3

This format is specific to the CALINE-3 dispersion model. The file contains only one type of formatted data record, one for each hour. The format for this record is described in Table F-22.

Table F-22

CALINE-3 Output Format

Field	Element/Description	Format	Column(s)	Missing Value
1	Wind speed (m/s)	F3.0	1-3	-9
2	Wind direction (nearest degree)	F4.0	4-7	-99
3	P-G stability category	I1	8	0
4	Mixing height (m)	F6.0	9-14	1000
5	Background concentration (ppm)	F4.0	15-18	0

RTDM

This format is specific to the RTDM dispersion model (default). The file contains only one type of formatted data record, one for each hour. The format of this record is described in Table F-23.

Table F-23

RTDM Output Format

Field	Element/Description	Format	Column(s)	Missing Value
1	Last 2 digits of year	I2	1-2	
2	Julian day of year	I3	3-5	
3	Hour in Local Standard Time (LST)	I2	6-7	
4	Wind direction (degrees)	F6.0	9-14	-999
5	Wind speed (miles/hr)	F6.1	15-20	-999
6	Mixing height (m)	F6.0	21-27	-999
7	P-G stability category	F6.0	28-33	-999
8	Temperature (°F)	F6.1	34-39	-999

The input variables listed above are the only ones allowed by current regulatory guidance. The RTDM dispersion model provides for specification of other meteorological variables but these require quite special meteorological observations, or at the very least an intimate knowledge of the meteorological conditions appropriate to the dispersion problem to be modeled.

VALLEY ISCLT CDM 2.0 (CDM16)

The input file describing the meteorological conditions for VALLEY, ISCLT, and the CDM16 option in CDM 2.0 is in the form of a joint frequency distribution. The distribution is constructed using 16 sectors, 6 wind speed classes, and 6 stability classes. The wind speed classes are 0-3, 3-6, 6-10, 10-16, 16-21 and >21 kts.

The stability categories for the CDM16 option of CDM 2.0 are:

P-G Class	Category	Description
1	A	Very unstable
2	B	Moderately unstable
3	C	Sightly unstable
4	D daytime)	Neutral (sunrise to sunset)
5	D (nighttime)	Neutral (sunset to sunrise)
6	E-F	Stable

The stability categories for the ISCLT and VALLEY dispersion models are:

P-G Class	Category	Description
1	A	Very unstable
2	B	Moderately unstable
3	C	Sightly unstable
4	D	Neutral
5	E	Stable
6	F	Very stable

The input files for these models are comprised of 96 records (i.e., one record for each sector/stability combination). Each record contains the frequency data for six wind speed classes. An example is presented in Figure D-19 in Appendix D.

CDM 2.0 (CDM36)

The input file describing the meteorological conditions for the CDM36 option of CDM 2.0 is in the form of a joint frequency distribution. The distribution is constructed using 36 sectors, 6 wind speed classes, and 6 stability classes. The wind speed classes are 0-3, 3-6, 6-10, 10-16, 16-21 and >21 kts.

The input file for the CDM36 option is comprised of 216 records (i.e., one record for each sector/stability combination). Each record contains the frequency data for six wind speed classes. An example is presented in Figure D-20 in Appendix D.

APPENDIX G

GLOSSARY

ABNORMAL JOB TERMINATION -- this statement, if found in the general report file, indicates that an error condition was detected and further processing has been inhibited.

ASCII -- American Standard Code for Information Interchange.

AUD Input -- an input image used to add variables to the default list of variables being tracked on the UA, SF or OS pathway during quality assessment.

Audit Summary -- a written summary of the results for the variables tracked (audited) during quality assessment.

Audit Variables -- variables that are tracked during quality assessment.

BBS -- Bulletin Board System

BLP -- Buoyant Line and Point source dispersion model (Appendix W to 40 CFR Part 51)

Bowen Ratio -- ratio of the upward flux of sensible heat to the energy flux used in evaporation; a measure of the relative evaporative power of the atmosphere.

CALINE3 -- A dispersion model used for estimating air concentrations near highways and arterials - developed by the State of California (Appendix W to 40 CFR Part 51.

CD-144 Format -- Card Deck-144 data format available from NCDC for National Weather Service surface observations commonly used for dispersion models. Each record represents an 80-column "card image".

CDM 2.0 -- Climatological Dispersion Model (Appendix W to 40 CFR Part 51)

COMPLEX1 -- A multiple source complex terrain screening model for use in regulatory modeling applications involving terrain above stack top (Appendix W to 40 CFR Part 51).

Convective Mixing -- mixing of atmospheric properties as a result of surface heating.

Dispersion Model -- A group of related mathematical algorithms used to estimate (model) the dispersion of pollutants in the atmosphere due to transport by the mean (average) wind and small scale turbulence.

DOS -- Disk Operating System.

EBCDIC -- Extended Binary Coded Decimal Interchange Code.

EOF -- End-of-File.

EPA -- U. S. Environmental Protection Agency.

Error message -- a message written by the processor to the error/message file whenever an error is encountered that will inhibit data processing.

Error/Message File -- a file used in all stages of processing for storage of messages written by the processor.

Extracted Data File -- the file resulting from Stage 1 processing for storage of data retrieved from a magnetic medium (disk or tape).

Extraction Process -- the process of retrieving data from a magnetic medium.

Fatal Error -- any error which inhibits further data processing on a pathway or stops the MPRM processor.

File Headers -- records written by the processor at the top of files during Stage 1 and Stage 2 processing. These records contain the input images from individual pathways in addition to supplementary records tracking the history of the data set.

Flow Vector -- The direction towards which the wind is blowing.

General Report File -- a file written either to the default output device or a disk file summarizing the processor results.

GMT -- Greenwich Mean Time, the time at the 0° meridian.

Harmonic Average Wind Speed -- $[\Sigma(1/u_i)/N]^{-1}$, where N is the total number of observations and u_i is the i^{th} wind speed observation. The harmonic average wind speed is used by the CDM dispersion model in computing the effects of dilution.

Height Intervals -- heights used for reporting the results of quality assessment of upper air data (see also Interval Thickness).

Hypsometric Formula -- a determination of the height difference between any two pressure levels based on hydrostatic balance, which requires the mean virtual temperature of the layer.

Information(al) message -- any message written to the error/message file that reports the status of the processing and further data processing is not affected.

Initial Status Report -- the first page of the general report for Stage 1 and Stage 2 processing.

Input Command Structure -- the syntax and sequence of the input images.

Input Image -- user supplied input, read through the default input device, controlling MPRM data processing.

Interval Thickness -- the height difference used in summarizing the quality assessment results of upper air data (see also Height Interval).

IQA -- Input to Quality Assessment, an input image that defines the output file to receive extracted data. This file also serves as the input file for the first pass through quality assessment of the data.

ISCST -- Industrial Source Complex - Short Term dispersion model (Appendix W to 40 CFR Part 51).

JB -- JoB, the 2-character code indicating that all fields on the input image pertain to the overall operation of the processor.

JB Data -- collective term for all input images that begin with the 2-character code JB.

JB Pathway -- collective term for logic associated with deciphering input images beginning with the JB character code.

JCL -- Job Control Language, an IBM mainframe's operating system control language for batch jobs.

Joint Frequency Function -- the joint frequency of wind direction sector, wind speed class and stability category (see also STAR).

Kb -- kilobyte (1000 bytes)

Keyword -- the 3-character codes that follow immediately after the pathway ID in the input run stream data.

Library Routines -- a collection of subroutines that are called by two or more subroutines and/or main program.

LST -- Local Standard Time.

Math Co-processor -- a computer chip used to speed up floating point arithmetic in a personal computer.

Mb -- megabyte (10^6 bytes)

Merged Data File -- the file produced by Stage 2 processing consisting of available upper air and mixing height data, surface observations and on-site data for a specified period of time.

Merge Processing -- the process by which data from the 3 pathways (UA, SF, OS) are combined to produce a merged data file.

Meteorological Data File -- any file containing meteorological data, whether it be upper air soundings, mixing heights, surface observations or on-site data, or any combination of these.

Missing Value -- alphanumeric character(s) that represent breaks in the temporal or spatial record of an atmospheric variable.

Mixing Height -- the depth through which atmospheric pollutants are typically mixed by dispersive processes.

Monthly Mean Value -- a one-month arithmetic average of a meteorological variable.

MPRM -- Meteorological Processor for Regulatory Models, the software described in this document.

MR -- MeRge, the 2-character code indicating that all fields on the input image pertain to combining of the data from the three pathways into a single unformatted file.

MR Data -- collective term for all input images that begin with the 2-character code MR.

MR Pathway -- collective term for logic associated with deciphering input images beginning with the MR character code.

NCDC -- National Climatic Data Center, the federal agency responsible for distribution of the National Weather Service upper air, mixing height and surface observation data.

NTIS -- National Technical Information Services, the agency responsible for distribution of technical information.

NWS -- National Weather Service.

OAQPS -- Office of Air Quality Planning and Standards

OQA -- Output from Quality Assessment, an input image that defines the output file to receive data that have gone through quality assessment. This file is also used as the input file for Stage 2 processing.

On-site Data -- data collected from a meteorological measurement program operated in the vicinity of the site to be modeled in the dispersion analysis.

Opaque Sky Cover -- the amount of sky cover, expressed in tenths, that completely obscures all that might be above it.

OS -- On-Site, the 2-character code indicating that all fields on the input image pertain to the processing of on-site data

OS Data -- collective term for all input images that begin with the 2-character code OS, also used to collectively refer to on-site data processed.

OS Pathway -- collective term for logic associated with deciphering input images beginning with the OS character code.

Overlay -- one or more subprograms that reside on disk and are loaded into memory only when needed.

Pasquill Stability Categories -- a classification of the dispersive capacity of the atmosphere, originally defined using surface wind speed, solar insolation (daytime) and cloudiness (nighttime). They have since been reinterpreted using various other meteorological variables.

Pathway -- one of the five major processing areas in MPRM. These are JB, OS, SF, UA, and MR (see these entries in this section for a description).

PC -- Personal Computer.

Processing Methodologies -- options controlling Stage 3 processing.

Quality Assessment -- judgment of the quality of the data.

Quality Assessment Check -- determining if the reported value of a variable is reasonable (see also Range Check).

Quality Assessment Message -- message written to the error/message file when a data value is determined to be suspect.

Quality Assessment Violation -- occurrences when data values are determined to be suspect (see also Range Check Violation).

RAM -- (1) Random Access Memory on a personal computer.
(2) A multiple source dispersion model.

RAMMET -- Meteorological processor program used for regulatory applications capable of processing twice-daily mixing heights (TD-9689 format) and hourly surface weather observations (CD-144 format) for use in dispersion models (Appendix W to 40 CFR Part 51).

Range Check -- determining if an observation of a variable falls within predefined upper and lower bounds.

Range Check Switch -- parameter whose value indicates whether to include or exclude the upper and lower bounds during range checks.

Range Check Violation -- determination that the value of a variable is outside range defined by upper and lower bound values (see also Quality Assessment Violation).

Raw Data File -- any file which has not been processed by MPRM

Regulatory Applications -- dispersion modeling involving regulatory decision-making as described in Appendix W to 40 CFR Part 51.

Regulatory Model -- a dispersion model that has been approved for use by EPA (Appendix W to 40 CFR Part 51).

Reporting Procedures -- options available in Stage 3 processing for reporting the availability of meteorological data for the selected dispersion model.

Roughness Length -- see Surface Roughness Length

RTDM -- Rough Terrain Dispersion Model. A multiple source complex terrain screening model for use in regulatory modeling applications involving terrain above stack top (Appendix W to 40 CFR Part 51).

Run Stream -- collectively, all input images required to process data in MPRM.

σ_A -- standard deviation of the horizontal wind direction fluctuations.

σ_E -- standard deviation of the vertical wind direction fluctuations.

σ_w -- standard deviation of the vertical wind speed fluctuations.

Scan report -- the report generated by MPRM processor summarizing the contents of a magnetic tape. This report is generated only if extraction is requested and no data are extracted from the tape.

SCRAM -- Support Center for Regulatory Air Models

SF -- SurFace, the 2-character code indicating that all fields on the input image pertain to the processing of NWS hourly surface weather observations.

SF Data -- collective term for all input images that begin with the 2-character code SF, also used to collectively refer to NWS hourly surface weather observations.

SFC Input -- keyword indicating on-site data supplied to the processor, consisting of surface albedo, Bowen ratio, and surface roughness length as a function of wind direction and time of year. This is an optional input.

SF Pathway -- collective term for logic associated with deciphering input images beginning with the SF character code.

SRDT -- Solar Radiation Delta-T; a method for estimating P-G stability using on-site measurements of wind speed coupled with solar radiation during the day and vertical temperature difference at night.

Stage 1 Processing -- the process of extracting or retrieving meteorological data from raw data files and subsequent quality assessment of the data, and all reports and files generated during this process.

Stage 2 Processing -- the process of combining or merging the three types of meteorological data into an unformatted file, and all reports and files generated during this process.

Stage 3 Processing -- the process of preparing meteorological data, processed in Stage 2, for use by a dispersion model, and all reports and files generated during this process.

Standard Reporting Levels -- mandatory pressure levels (and corresponding measured atmospheric quantities) in a NWS upper air sounding.

STAR -- (STability ARray) stability and wind rose summary, a joint frequency distribution summary of stability category, wind speed and wind direction. The STAR data are used as input for several long-term dispersion models such as CDM and ISCLT.

Station Identification -- an integer or character string used to uniquely identify a station or site as provided in the upper air (TD-5600 and TD-6201), mixing height (TD-9689), and surface weather (CD-144 and TD-3280) data formats available from NCDC. There are no standard station numbers for on-site data and the user may include any integer or character string up to eight digits or characters.

Storage Formats -- For magnetic tapes, the formats available from NCDC for storing upper air and surface observations. See TD-1440, TD-3280, TD-5600, TD-6201, TD-9689 and CD-144. For on-site data 'storage formats' refers to the format of the data on the input file.

Subdirectory -- a directory below the root, or highest level, directory or another subdirectory, used for organization of files on a storage medium such as a PC hard disk.

Surface Albedo -- fractional amount of radiation incident on a surface that is reflected away from the surface.

Surface Weather Observations -- a collection of atmospheric data on the state of the atmosphere as observed from the earth's surface. In the U.S. the National Weather Service collect these data on a regular basis at selected locations.

Surface Roughness Length -- height at which the wind speed extrapolated from a near-surface wind speed profile becomes zero.

TD-1440 Format -- a format available from NCDC for summarizing NWS surface observations in an 80-column format; the CD-144 format is a subset of this format. This format has been superseded by the TD-3280 format.

TD-3280 Format -- the current format available from NCDC for summarizing NWS surface weather observations in an elemental structure, i.e., observations of a single atmospheric variable are grouped together for a designated period of time.

TD-5600 Format -- a format available from NCDC for reporting NWS upper air sounding data. This format has been superseded by the TD-6201 format.

TD-6201 Format -- the current format available from NCDC for reporting NWS upper air data. The file structure is essentially the same as the TD-5600 format except that there is more quality assurance information.

TD-9689 Format -- the format available from NCDC for mixing heights estimated from morning upper air temperature and pressure data and hourly surface observations of temperature.

Temperature lapse rate -- the fall of temperature per unit height, and is taken as positive when temperature decreases with height.

TTN -- Technology Transfer Network

Total Sky Cover -- the amount of sky, expressed in tenths, covered by a combination of transparent and opaque clouds or obscuring phenomena.

Turbulence -- The irregular "eddy" motions in fluids, whether liquid or gaseous, which cause an irreversible mixing of fluid properties between neighboring parcels.

UA -- Upper-Air, the 2-character code indicating that all fields on the input image pertain to the processing of the twice-daily mixing height data and the upper air data.

UA Data -- collective term for all input images that begin with the 2-character code UA, also used to collectively refer to mixing height and upper air data processed.

UA Pathway -- collective term for logic associated with deciphering input images beginning with the UA character code.

Unformatted File -- a file written without the use of a Fortran FORMAT statement.

Upper Air Data (or soundings) -- meteorological data obtained from balloon-borne instrumentation that provides information on pressure, temperature, humidity, and wind away from the surface of the earth.

UTC -- Universal Time Coordinate

VALLEY -- a complex terrain dispersion model used as a first level screening model in regulatory dispersion modeling (Appendix W to 40 CFR Part 51).

Warning Message -- a message written by the processor to the error/message file whenever a problem arises that may inhibit further data processing.

Wind Shear -- the change in wind velocity with height.