Algorithm 3B-43 User's Guide

Version 1.5

August 9, 1999

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1.0 PROCESSING OVERVIEW

The purpose of Algorithm 3B-43 is to produce the "Tropical Rainfall Measuring Mission (TRMM) and Other Data" best-estimate precipitation rate and root-mean-square (RMS) precipitation-error estimates (3B-43). These gridded estimates are on a calendar month temporal resolution and a 1-degree by 1-degree spatial resolution global band extending from 40 degrees south to 40 degrees north in latitude.

Algorithm 3B-43 consists of a single algorithm, L3B43main, which is executed once per calendar month. To produce the single, best-estimate precipitation rate and RMS precipitation-error estimate field (3B-43), algorithm L3B43main combines two independent precipitation fields, the daily-average adjusted merged-infrared (IR) estimate (3B-42) and the monthly accumulated Climate Assessment and Monitoring System (CAMS) or Global Precipitation Climatology Centre (GPCC) rain gauge analysis (3A-45).

Before algorithm L3B43main merges the two independent precipitation estimates, some preprocessing of the data fields is required. All input data sources are required to be on the calendar month temporal resolution. To obtain the requisite calendar month average of adjusted merged-IR data, L3B43main averages the adjusted merged-IR days that span the calendar month of interest. After the preprocessing is complete, the two independent precipitation fields are merged together to form the best-estimate precipitation rate and RMS precipitation-error estimates. The details concerning algorithm L3B43main processing are provided in Section 2.0.

Algorithm L3B43main is compiled and linked using the makefile supplied, and is executed as shown in the example command line. The details of the command-line syntax for executing algorithm L3B43main are provided in Section 4.0.

2.0 EXECUTION PROCEDURES

Algorithm L3B43main is executed once for each calendar month, and processes a month of data in each execution. Each of the two independent precipitation sources - daily adjusted merged-IR and monthly rain gauge - are read and processed in preparation for combining these individual fields into one best-estimate calendar-month-average precipitation rate and RMS precipitation-error field (Product 3B-43).

L3B43main first processes the days of adjusted merged-IR precipitation rate and RMS precipitation-error data (Product 3B-42), which are stored in HDF. Because Product 3B-43 is on the calendar month resolution, a calendar month average of the adjusted merged-IR data must be computed from the adjusted merged-IR days spanning that calendar month. Below is a table showing the range of adjusted merged-IR days that will be used in computing each calendar month average for non-leap years.

Calendar Month	Required Adjusted merged-IR Days (Day of year)
January	1 - 31
February	32 - 59
March	60 - 90
April	91 - 120
May	121 - 151
June	152 - 181
July	182 - 212
August	213 - 243
September	244 - 273
October	274 - 304
November	305 - 334
December	335 - 365

For leap years, the end day of February becomes 60 and all following monthly begin and end days are incremented by one. After the monthly-averaged adjusted merged-IR data field is computed, the additive merged-IR calibration parameter from L3B42main1 is applied. From analysis, it was determined that the additive constant, unlike the multiplicative constant applied in algorithm L3B42main2, is only applicable at the monthly timescale. As a result, the sum of the daily fields (Product 3B-42) will not equal the monthly adjusted merged-IR field.

The second precipitation source processed by L3B43main is the rain gauge data, which can be either the GPCC or the CAMS data. Based on the input command-line rain gauge file name, L3B43main automatically detects the source of the data and processes the file accordingly. The GPCC precipitation data, stored in an ASCII character file, is on the 1.0-degree latitude-longitude resolution. The CAMS precipitation data, stored in a flat binary file, is on the 0.5-degree latitude-longitude resolution. After the CAMS rain gauge data is read, it is regridded to the 1-degree by 1-degree resolution for consistency with the

other
precipitation data sources. Based on the GPCC or regridded CAMS precipitation
rates, an associated precipitation error is estimated.

After the two input precipitation sources have been read and preprocessed, L3B43main first adjusts the monthly adjusted merged-IR data estimate to match the large-scale bias of the rain gauge analysis. This gauge-adjusted satellite
estimate is then used with the rain gauge data to compute the combined satellite-rain gauge precipitation rate and RMS precipitation-error estimates, which is TSDIS Product 3B-43. This product is output in HDF.

Two ancillary files are required for algorithm L3B43main processing. The first
ancillary file contains the percent surface water coverage, stored in binary format, for use in smoothing the individual satellite precipitation fields in geographical locations where coincident rain gauge data is available. The data
are stored in a single file, and this same file is used in every execution of algorithm L3B43main. The second ancillary file contains rain gauge bias factors, stored in binary format, which are multiplied with the regridded GPCC or CAMS rain gauge precipitation data to correct for known rain gauge biases. The data are stored in 12 separate files, one for each calendar month. Based on the input command-line 2-digit month, algorithm L3B43main reads and applies the rain gauge bias data from the appropriate monthly file.

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IMPORTANT NOTE!!!!

The SSM/I (3A-46), intermediate TMI data from algorithm L3B42main1, and TCI/TMI
calibration parameters (3B-31) processing has been eliminated from the latest version of algorithm L3B43main as it is believed that these data are diurnally biased at the monthly time scale. However, the infrastructure for processing this data has been maintained in the code and the command-line structure for possible future use.
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The details concerning algorithm L3B43main command-line arguments are provided in Section 4.0 and descriptions of the related input and output files are given
in Section 5.0. Important processing notes are presented in Section 6.0. Section 8.0 provides detailed descriptions of algorithm L3B43main error and warning messages, and related user actions, and Section 9.0 gives user actions in the event of L3B43main failure in unusual circumstances.

3.0 REQUIRED RESOURCES

This section summarizes the required system resources for hosting and executing
algorithm L3B43main in the TSDIS operational environment. The following table summarizes estimates of the resource requirements for algorithm L3B43main. These numbers are derived from tests using synthetic data sets generated in Code 912, and may change when actual data sets are used. All tests were performed on a lightly-loaded, 250 megahertz Silicon Graphics workstation.

Resource	Requirement
CPU Usage	22 seconds
Memory	14 megabytes
Output Data Disk File Space	0.3 megabyte
Intermediate Data Disk File Space	<none>
Ancillary Data Disk File Space	3.4 megabytes

4.0 INPUT PARAMETERS DESCRIPTION

This section describes the input command-line parameters necessary to execute algorithm L3B43main. The command-line syntax for executing algorithm L3B43main is as follows:

L3B43main infile

where L3B43main is the name of the executable and "infile" is a simple ASCII file containing the input command-line arguments, one per line. The command-line argument structure within "infile" is as follows:

```
<L3B42main1 interm monthly unclipped TMI file id>
<L3B42main1 output IR monthly cal parms file id>
<3B31 file id>
<3A46 file id>
<3A45 file id>
<3B43 output file id>
<L3B43main log file id>
<year>
<month>
<number of 3B-42 files>
<3B42 file id1>
<3B42 file id2>
<3B42 file id3>
      .
      .
      .
<3B42 file idn>
```

where each command-line argument is denoted by brackets (<>), and "interm" denotes intermediate. The argument <3B42 number of files> is the number of daily adjusted merged-IR files which will nominally be the number of days in the month, ranging from 28 - 31. The corresponding number of adjusted merged-IR files will follow. The naming convention for the command-line input/output files required for algorithm L3B43main execution is provided in Reference 2. The naming convention for the ancillary files is given in Appendix A. A brief description of each command-line argument is given below. The details concerning each input and output file listed on the command line are given in Section 5.0. Note that the data files provided by the following arguments - <L3B42main1 interm monthly unclipped TMI file id>, <3B31 file id>, and <3A46 file id> - are currently not used, however, dummy file names must be entered regardless (see note in Section 2.0).

<L3B42main1 interm monthly unclipped TMI file id>

Name of the input binary file containing the calendar month average of unclipped TMI precipitation rate and observation count data output from algorithm L3B42main1. [currently not used - see note in Section 2.0]

<L3B42main1 output monthly IR cal parms file id>

Name of the input binary file, output from algorithm L3B42main1, containing the calendar month of IR calibration parameters corresponding to the current month.

<3B31 file id>

Name of the input HDF file containing the calendar month of TMI/TCI calibration parameters (Product 3B-31). [currently not used - see note in Section 2.0]

<3A46 file id>

Name of the input HDF file containing the calendar month of SSM/I precipitation rate and observation count data (Product 3A-46). [currently not used - see note in Section 2.0]

<3A45 file id>

Name of the input file containing the calendar month of accumulated rain gauge precipitation and rain gauge population data (Product 3A-45). If the source of the data is GPCC, the file is in ASCII character format. If the source of the data is CAMS, the file is in flat binary format.

<3B43 output file id>

Name of the output HDF file containing the current calendar month of "TRMM and Other Data" best-estimate precipitation rate and RMS precipitation-error estimate data (Product 3B-43).

<L3B43main log file id>

Name of the output ASCII text file containing execution status and error messages for the current execution. This file name must always be specified.

<year>

4-digit year of the current calendar month.

<month>

2-digit number of the current calendar month.

<number of 3B-42 files>

2-digit number of daily adjusted merged-IR files for the calendar month. This number ranges from 28 to 31.

<3B42 file1 ids>

Names of the input HDF files containing the days of adjusted merged-IR precipitation rate and RMS precipitation-error estimate data (Product 3B-42) spanning the current calendar month. The number of files is specified in the argument <number of 3B-42 files>.

5.0 INPUT/OUTPUT/ANCILLARY FILE DESCRIPTIONS

This section provides the details of the input, output and ancillary files used by algorithm L3B43main. The files are described in the following order - input-only, output-only, and ancillary. Each individual file is described in terms of contents, granularity, and high-level format. References for the detailed file formats are provided. The naming convention for the command-line input/output files required for algorithm L3B43main execution is provided in Reference 2. The naming convention for the ancillary files is given in Appendix A.

INPUT-ONLY DATA:

Monthly Average Unclipped TMI Data File:
[currently not used - see note in Section 2.0]

Contents: Monthly average TMI precipitation rate, number of valid observations, and number of ambiguous observations gridded to a 1-degree by 1-degree resolution global band extending from 40 degrees south to 40 degrees north latitude
Granularity: One calendar month
Format: Flat binary format. The detailed structure of this file is given in Appendix B.

Monthly IR Calibration Parameters File:

Contents: Monthly IR multiplicative and additive calibration parameters gridded to a 1-degree by 1-degree resolution global band extending from 40 degrees south to 40 degrees north latitude
Granularity: One calendar month
Format: Flat binary format. The detailed structure of this file is given in Appendix B.

TMI/TCI 3B-31 Calibration Parameters File:
[currently not used - see note in Section 2.0]

Contents: Monthly TCI/TMI calibration parameters, used to calibrate the monthly average unclipped TMI data, gridded to a 5-degree by 5-degree resolution global band extending from 40 degrees south to 40 degrees north latitude
Granularity: One calendar month
Format: HDF. The detailed structure of this file can be found in Reference 3.

Monthly SSM/I 3A-46 Precipitation Data File:
[currently not used - see note in Section 2.0]

Contents: Monthly SSM/I precipitation rate and observation count

data gridded to a 1-degree by 1-degree global resolution extending from 90 degrees south to 90 degrees north latitude
Granularity: One calendar month
Format: HDF. The detailed structure of this file can be found in Reference 3.

Monthly Rain Gauge 3A-45 Precipitation Data File:

Contents: GPCC: Monthly accumulated rain gauge precipitation and rain gauge population data gridded to a 1.0-degree by 1.0-degree global resolution extending from 90 degrees south to 90 degrees north latitude
CAMS: Monthly accumulated rain gauge precipitation and rain gauge population data gridded to a 0.5-degree by 0.5-degree global resolution extending from 90 degrees south to 90 degrees north latitude
Granularity: One calendar month
Format: GPCC: ASCII character format. The detailed structure of this file can be found in Reference 4.
CAMS: Flat binary format. The detailed structure of this file can be found in Reference 5.

Daily Adjusted merged-IR 3B-42 Precipitation Data File:

Contents: Days of adjusted merged-IR precipitation rate and RMS precipitation-error estimate gridded to a 1-degree by 1-degree resolution global band extending from 40 degrees south to 40 degrees north latitude
Granularity: One day
Format: HDF. The detailed structure of this file is given in Reference 3.

OUTPUT-ONLY DATA:

L3B43main Output Log File:

Contents: Execution status and error messages
Granularity: One per month processed
Format: ASCII text

Monthly "TRMM and Other Data" 3B-43 Precipitation Data File:

Contents: Month of best-estimate, combined satellite-rain gauge precipitation rate and RMS precipitation-error estimate gridded to a 1-degree by 1-degree resolution global band extending from 40 degrees south to 40 degrees north latitude
Granularity: One calendar month
Format: HDF. The detailed structure of this file is given in Reference 3.

ANCILLARY DATA:

Percent Surface Water Data File:

Contents: Percent of geographical surface covered by water for every 1-degree by 1-degree global gridbox extending from 90 degrees south to 90 degrees north latitude
Granularity: One calendar month
Format: Flat binary format. The detailed structure of this file is given in Appendix B.

Rain Gauge Bias Data File:

Contents: Multiplicative rain gauge bias factor for every 1-degree by 1-degree global gridbox extending from 90 degrees south to 90 degrees north latitude
Granularity: One calendar month
Format: Flat binary format. The detailed structure of this file is given in Appendix B.

6.0 PROCESSING ASSUMPTIONS AND RESTRICTIONS

This section lists important processing notes regarding algorithm L3B43main.

(1) The TSDIS scheduler *must* know which days of adjusted merged-IR data are required, as input, for each execution of algorithm L3B43main. A table showing this relationship is provided in Section 2.0.

(2) The percent surface water and 12 rain gauge bias ancillary files *must* be in the same directory as the L3B43main executable.

7.0 LIBRARIES

Algorithm L3B43main requires the use of the General Meteorological Package character string manipulation routines. These routines are provided in the form of an archive library with the L3B43main package distribution. GEMPAK is a licensed product, and as such the libraries provided must not be distributed without permission.

8.0 ERROR/WARNING MESSAGES

This section details the error/warning messages specific to algorithm L3B43main. Below is a comprehensive list of the algorithm-specific error/warning messages returned by the TSDIS toolkit during L3B43main execution. Included with each error/warning message is a brief description of the possible causes of the message and a set of user actions to be taken by the operator in response to the error/warning message. Additional information concerning algorithm L3B43main error and warning messages, when they are generated, can be found in the output log file. The error/warning messages are listed below in mnemonic alphabetical order.

NOTE: The naming convention of any input/output files referenced in the algorithm-specific error/warning messages can be found in Reference 2. The naming convention of the ancillary files is given in Appendix A.

ERROR MESSAGES:

E_3B43_ERROR_CLOSING_3A46_FILE;
Algorithm 3B-43: Error closing 3A-46 file

Possible Cause(s): Probable disk/file system problem.

Action(s): Examine TSDIS toolkit return code and perform appropriate actions.

E_3B43_ERROR_CLOSING_3B31_FILE;
Algorithm 3B-43: Error closing 3B-31 file

Possible Cause(s): Probable disk/file system problem.

Action(s): Examine TSDIS toolkit return code and perform appropriate actions.

E_3B43_ERROR_CLOSING_3B42_FILE;
Algorithm 3B-43: Error closing 3B-42 file

Possible Cause(s): Probable disk/file system problem.

Action(s): Examine TSDIS toolkit return code and perform appropriate actions.

E_3B43_ERROR_CLOSING_3B43_FILE;
Algorithm 3B-43: Error closing 3B-43 file

Possible Cause(s): Probable disk/file system problem.

Action(s): Examine TSDIS toolkit return code and perform appropriate actions.

E_3B43_ERROR_CLOSING_CPFILE;
Algorithm 3B-43: Error closing calibration parameters file

Possible Cause(s): File containing the input IR calibration parameters may have been corrupted during L3B43main execution.

Action(s): Normally, no operator action is required. However, if the file is not the correct size (230400 bytes), delete the corrupted file, and restore the pre-run version of the IR calibration parameters file, delete the output 3B-43 data file (if one was created), and re-execute L3B43main.

E_3B43_ERROR_CLOSING_LOGFILE;
Algorithm 3B-43: Error closing 3B-43 log file

Possible Cause(s): File used to store the L3B43main execution status and error/warning messages has been corrupted during L3B43main execution.

Action(s): None required.

E_3B43_ERROR_CLOSING_RGBFILE;
Algorithm 3B-43: Error closing rain gauge bias file

Possible Cause(s): Monthly ancillary rain gauge bias data file may have been corrupted during L3B43main execution.

Action(s): Normally, no operator action is required. However, if the file is not the correct size (259200 bytes), delete the corrupted file, restore the pre-run (uncorrupted) version of the monthly rain gauge bias file, and reexecute L3B43main.

E_3B43_ERROR_CLOSING_RGFILE;
Algorithm 3B-43: Error closing rain gauge data file

Possible Cause(s): GPCC or CAMS rain gauge data file may have been corrupted during L3B43main execution.

Action(s): Normally, no operator action is required. However, if the file is corrupted, delete the corrupted file, restore the pre-run (uncorrupted) version of the GPCC or CAMS rain gauge data file, and reexecute L3B43main.

E_3B43_ERROR_CLOSING_SURFFILE;
Algorithm 3B-43: Error closing percent surface water file

Possible Cause(s): Ancillary percent surface water file may have been corrupted during L3B43main execution.

Action(s): Normally, no operator action is required. However, if the file is not the correct size (259200 bytes), delete the corrupted file, restore the pre-run (uncorrupted) version of the percent surface water file, and reexecute L3B43main.

E_3B43_ERROR_CLOSING_TMIFILE;
Algorithm 3B-43: Error closing TMI monthly unclipped data file

Possible Cause(s): TMI monthly average unclipped precipitation and observation count data file may have been corrupted during L3B43main execution.

Action(s): Normally, no operator action is required. However, if the file is not the correct size (345600 bytes), delete the corrupted file, restore the pre-run (uncorrupted) version of the TMI monthly average unclipped data file, and reexecute L3B43main.

E_3B43_ERROR_IN_CHTOINT_CONVERT;
Algorithm 3B-43: Error converting characters to integers

Possible Cause(s): Input command-line month, year or number of 3B-42 files is not valid numbers. Month and number of 3B-42 files must be a two-digit number and year must be a 4-digit number.

Action(s): Enter the correct 2-digit month, 2-digit number of 3B-42 files, or 4-digit year in the command-line argument list and re-execute L3B43main.

E_3B43_ERROR_IN_RGFILE_NAME;
Algorithm 3B-43: Unable to identify rain gauge data type

Possible Cause(s): Input command-line GPCC or CAMS rain gauge data file name is incorrect. The file name must conform to the TSDIS file naming convention.

Action(s): Enter the correct name for the GPCC or CAMS rain gauge data file and re-execute L3B43main.

E_3B43_ERROR_IN_RGFILE_NLENGTH;
Algorithm 3B-43: Error in rain gauge file name length

Possible Cause(s): Input command-line GPCC or CAMS rain gauge data file name is invalid. The file name must be a valid UNIX file name.

Action(s): Enter the correct file name for the GPCC or CAMS rain gauge data file in the command-line argument list and re-execute L3B43main.

E_3B43_ERROR_OPENING_3A46_FILE;
Algorithm 3B-43: Error opening 3A-46 file

Possible Cause(s): (1) Input command-line 3A-46 file name is incorrect or (2) 3A-46 file does not exist or is corrupted.

Action(s): Examine TSDIS toolkit return code, perform appropriate actions, and re-execute L3B43main.

E_3B43_ERROR_OPENING_3B31_FILE;
Algorithm 3B-43: Error opening 3B-31 file

Possible Cause(s): (1) Input command-line 3B-31 file name is incorrect or (2) 3B-31 file does not exist or is corrupted.

Action(s): Examine TSDIS toolkit return code, perform appropriate actions, and re-execute L3B43main.

E_3B43_ERROR_OPENING_3B42_FILE;
Algorithm 3B-43: Error opening 3B-42 file

Possible Cause(s): (1) Input command-line 3B-42 file name is incorrect or (2) 3B-42 file does not exist or is corrupted.

Action(s): Examine TSDIS toolkit return code, perform appropriate actions, and re-execute L3B43main.

E_3B43_ERROR_OPENING_3B43_FILE;
Algorithm 3B-43: Error opening 3B-43 file

Possible Cause(s): (1) Insufficient disk space available to create the 3B-43 file or (2) incorrect path specified in input file name

Action(s): Examine TSDIS toolkit return code, perform appropriate actions, and re-execute L3B43main.

E_3B43_ERROR_OPENING_CPFILE;
Algorithm 3B-43: Error opening calibration parameters file

Possible Cause(s): (1) Input command-line IR calibration parameters file name is incorrect or (2) the IR calibration parameters file does not exist or is corrupted.

Action(s): (1) Enter the correct file name for the IR calibration parameters file in the command-line argument list and re-execute L3B43main or (2) If the file is corrupted, delete the corrupted file, restore the pre-run version of the IR calibration parameters file, and re-execute L3B43main.

E_3B43_ERROR_OPENING_LOGFILE;
Algorithm 3B-43: Error opening 3B-43 log file

Possible Cause(s): Insufficient disk space available to create the output log file.

Action(s): Ensure there exists sufficient space to create the output log file and re-execute L3B43main.

E_3B43_ERROR_OPENING_RGBFILE;
Algorithm 3B-43: Error opening rain gauge bias file

Possible Cause(s): (1) The required ancillary rain gauge bias file does not exist in the directory of the executable or (2) The file is corrupted.

Action(s): (1) Ensure the required monthly rain gauge bias file exists in the same directory as the L3B43main executable and re-execute

L3B43main or (2) If the file is not the correct size (259200 bytes), delete the corrupted file, restore the pre-run (uncorrupted) version of the monthly rain gauge bias file, and re-execute L3B43main.

E_3B43_ERROR_OPENING_RGFILE;
Algorithm 3B-43: Error opening rain gauge data file

Possible Cause(s): (1) Input command-line GPCC or CAMS rain gauge data file name is incorrect or (2) The GPCC or CAMS rain gauge file does not exist or is corrupted.

Action(s): (1) Enter the correct file name for the GPCC or CAMS rain gauge data file in the command-line argument list and re-execute L3B43main or (2) If the rain gauge data file is corrupted, delete the corrupted file, restore the pre-run (uncorrupted) version of the GPCC or CAMS rain gauge data file, and re-execute L3B43main.

E_3B43_ERROR_OPENING_SURFFILE;
Algorithm 3B-43: Error opening percent surface water file

Possible Cause(s): (1) The required ancillary percent surface water file does not exist in the directory of the executable or (2) The file is corrupted.

Action(s): (1) Ensure the percent surface water file exists in the same directory as the L3B43main executable and re-execute L3B43main or (2) If the file is not the correct size (259200 bytes), delete the corrupted file, restore the pre-run (uncorrupted) version of the percent surface water file, and re-execute L3B43main.

E_3B43_ERROR_OPENING_TMIFILE:
Algorithm 3B-43: Error opening TMI monthly unclipped data file

Possible Cause(s): (1) Input command-line TMI monthly average unclipped precipitation rate and observation count data file name is incorrect or (2) TMI monthly average unclipped precipitation and observation count data file does not exist or is corrupted.

Action(s): (1) Enter the correct file name for the TMI monthly average unclipped data file in the command-line argument list and re-execute L3B43main or (2) If the file is not the correct size (345600 bytes), delete the corrupted file, restore the pre-run (uncorrupted) version of the TMI monthly average unclipped data file, and re-execute L3B43main.

E_3B43_ERROR_READING_3A46_FILE;
Algorithm 3B-43: Error reading 3A-46 file

Possible Cause(s): 3A-46 file may be corrupted.

Action(s): Examine TSDIS toolkit return code, perform appropriate actions, and re-execute L3B43main.

E_3B43_ERROR_READING_3B31_FILE;
Algorithm 3B-43: Error reading 3B-31 file

Possible Cause(s): 3B-31 file may be corrupted.

Action(s): Examine TSDIS toolkit return code, perform appropriate actions, and re-execute L3B43main.

E_3B43_ERROR_READING_3B42_FILE;
Algorithm 3B-43: Error reading 3B-42 file

Possible Cause(s): 3B-42 file may be corrupted.

Action(s): Examine TSDIS toolkit return code, perform appropriate actions, and re-execute L3B43main.

E_3B43_ERROR_READING_CPFILE;
Algorithm 3B-43: Error reading calibration parameters file

Possible Cause(s): Input monthly IR calibration parameters file is corrupted.

Action(s): If the file is not the correct size (230400 bytes), delete the corrupted file, restore the pre-run version of the calibration parameters file, and re-execute L3B43main.

E_3B43_ERROR_READING_RGBFILE;
Algorithm 3B-43: Error reading rain gauge bias file

Possible Cause(s): Monthly ancillary rain gauge bias file is corrupted.

Action(s): If the file is not the correct size (259200 bytes), delete the corrupted rain gauge bias file, restore the pre-run (uncorrupted) version of the file, and re-execute L3B43main.

E_3B43_ERROR_READING_RGFILE;
Algorithm 3B-43: Error reading rain gauge data file

Possible Cause(s): The GPCC or CAMS rain gauge file is corrupted.

Action(s): If the rain gauge data file is not the correct size, delete the corrupted file, restore the pre-run (uncorrupted) version of the GPCC or CAMS rain gauge data file, and re-execute L3B43main.

E_3B43_ERROR_READING_SURFFILE;
Algorithm 3B-43: Error reading percent surface water file

Possible Cause(s): Ancillary percent surface water file is corrupted.

Action(s): If the file is not the correct size (259200 bytes), delete the corrupted file, restore the pre-run (uncorrupted) version of the percent surface water file, and re-execute L3B43main.

E_3B43_ERROR_READING_TMIFILE;
Algorithm 3B-43: Error reading TMI monthly unclipped data file

Possible Cause(s): Input TMI monthly average unclipped precipitation

rate and observation count data file is corrupted.

Action(s): If the file is not the correct size (345600 bytes), delete the corrupted file, restore the pre-run (uncorrupted) version of the TMI monthly average unclipped data file, and re-execute L3B43main.

E_3B43_ERROR_WRITING_3B43_FILE;
Algorithm 3B-43: Error writing 3B-43 file

Possible Cause(s): Possible disk/file system problem.

Action(s): Examine TSDIS toolkit return code, perform appropriate actions, and re-execute L3B43main.

E_3B43_ERROR_WRITING_3B43_MDATA;
Algorithm 3B-43: Error writing metadata to 3B-43 file

Possible Cause(s): Possible disk/file system problem.

Action(s): Examine TSDIS toolkit return code, perform appropriate actions, and re-execute L3B43main.

E_3B43_INCORRECT_NUMBER_CLARGS;
Algorithm 3B-43: Incorrect number of command line arguments

Possible Cause(s): (1) The input file name of the command-line arguments file is incorrect or (2) The number of command-line arguments within the file does not match the number of command-line arguments expected by L3B43main.

Action(s): (1) Correct the input file name containing the command-line arguments or (2) enter the correct number of arguments in the input file, one argument per line, and re-execute L3B43main.

E_3B43_INMONTH_NOT_VALID;
Algorithm 3B-43: Input month number not valid

Possible Cause(s): Input command-line 2-digit month number is invalid. The month number must be a number between 1 and 12, inclusive.

Action(s): Specify the correct number of 2-digit month number in the command-line argument list and re-execute L3B43main.

E_3B43_INVALID_RGFILE_INDICATOR;
Algorithm 3B-43: Invalid rain gauge indicator detected

Possible Cause(s): Input command-line GPCC or CAMS rain gauge data file name is incorrect. The file name must conform to the TSDIS file naming convention.

Action(s): Enter the correct name for the GPCC or CAMS rain gauge data file and re-execute L3B43main.

9.0 SPECIAL CONDITIONS

In most cases, abnormal termination of L3B43main will be handled in a controlled manner by the TSDIS toolkit error/warning routines. The details of the L3B43main-specific error/warning codes, and the appropriate user actions, are provided in Section 8.0. However, in rare instances, L3B43main may terminate prematurely due to unforeseen circumstances, such as a power outage. When termination of this nature occurs, the TSDIS operator must perform the actions listed below.

NOTE: The naming convention of any input/output files referenced below can be found in Reference 2. The naming convention of the ancillary files is given in Appendix A.

(1) Delete the monthly "TRMM and Other Data" 3B-43 data file, if one was created in the abnormally-terminated L3B43main execution.

(2) Ensure that the monthly TMI unclipped data (from L3B42main1), the TMI/TCI calibration parameters (3B-31), the days of adjusted merged-IR data (3B-42), the monthly SSM/I data (3A-46), and the monthly rain gauge data (3A-45) files have not been corrupted. If they are corrupt, replace the corrupted files with their corresponding pre-run (uncorrupted) versions.

(3) Ensure that the ancillary percent surface water and the rain gauge bias files have not been corrupted. If they are corrupt, replace the corrupted files with their corresponding pre-run (uncorrupted) versions.

(4) Re-execute L3B43main.

10.0 REFERENCES

1. "Algorithm 3B-42 User's Guide, Version 1.1", June 13, 1997.

2. "Tropical Rainfall Measuring Mission Science Data and Information System (TSDIS) Software Design Specification, TSDIS-P403, Volume 6A - Data Manager, Version 1", NASA Goddard Space Flight Center, October 1, 1996.

3. "Interface Control Specification Between the Tropical Rainfall Measuring Mission Science Data and Information System (TSDIS) and the TSDIS Science User (TSU), TSDIS-P907, Volume 4, File Specifications for TSDIS Products - Level 2 and Level 3", NASA Goddard Space Flight Center, June 28, 1996.

4. http://www.dwd.de/research/gpcc

5. cams_TRMM.doc file at anonymous FTP site ftp.ncep.noaa.gov in directory pub/precip/TRMM

11.0 GLOSSARY

CAMS	Climate Assessment and Monitoring System
GPCC	Global Precipitation Climatology Centre
HDF	Hierarchical Data Format
IR	infrared
RMS	root-mean-square
SSM/I	Special Sensor Microwave/Imager
TCI	TRMM Combined Instrument
TMI	TRMM Microwave Imager
TRMM	Tropical Rainfall Measuring Mission
TSDIS	TRMM Science Data and Information System

12.0 APPENDIX A: ANCILLARY FILE NAMING CONVENTION

The file naming convention for the algorithm L3B43main ancillary files is given
below. Note that these files must reside in the same directory as the L3B43main executable.

PERCENT SURFACE WATER DATA FILE:

Name: surfrac.XXX.tsdis

where

XXX is the version number
(e.g., '1.0' for version 1.0)

RAIN GAUGE BIAS DATA FILE

Name: error_XXX_YY.tsdis

where

XXX is the version number
(e.g., '1.0' for version 1.0)

YY is the calendar month number
(e.g., '02' for February)

13.0 APPENDIX B: SELECTED FILE FORMATS

This appendix gives the detailed file formats of selected files used by algorithm L3B43main. These files consist of the monthly average unclipped TMI data file, the percent surface water data file, and the monthly rain gauge bias
data file. All files are in flat binary format. All arrays are dimensioned using the "FORTRAN order" convention, opposite to the "C order" convention. The detailed structure of each file is given below.

MONTHLY AVERAGE UNCLIPPED TMI DATA FILE

File Size: 345600 bytes
File Structure: One record
Record Structure: One 3-dimensional, 4-byte floating-point array of dimension (lat,lon,parm)

lat: [1 - 80]

1 degree latitude gridboxes starting at 40 degrees south and extending to 40 degrees north; the center of the starting gridbox is 39.5 degrees south

lon: [1 - 360]

1 degree longitude gridboxes starting at the international date line and extending eastward back around to the international date line; the center of the starting gridbox is 179.5 degrees west

parm: [1] average unclipped TMI monthly precipitation rate (millimeters/hour)
[2] accumulated monthly unclipped TMI number of valid observations
[3] accumulated monthly unclipped TMI number of ambiguous observations

MONTHLY IR CALIBRATION PARAMETERS FILE

File Size: 230400 bytes
File Structure: One record
Record Structure: One 3-dimensional, 4-byte floating-point array of dimension (lat,lon,parm)

lat: [1 - 80]

1 degree latitude gridboxes starting at 40 degrees south and extending to 40 degrees north; the center of the starting gridbox is 39.5 degrees south

lon: [1 - 360]

1 degree longitude gridboxes starting at the international date line and extending eastward back around to the international date line; the center of the starting gridbox is 179.5 degrees west

parm: [1] multiplicative IR calibration parameter
[2] additive IR calibration parameter

PERCENT SURFACE WATER DATA FILE

File Size: 259200 bytes
File Structure: One record
Record Size: One 2-dimensional, 4-byte floating-point array of dimension (lat,lon)

lat: [1 - 180]

1 degree latitude gridboxes starting at 90 degrees south and extending to 90 degrees north; the center of the starting gridbox is 89.5 degrees south

lon: [1 - 360]

1 degree longitude gridboxes starting at the international date line and extending eastward back around to the international date line; the center of the starting gridbox is 179.5 degrees west

The data consist of the percentage of the surface, contained within each 1-degree by 1-degree gridbox, that is occupied by water. If the gridbox contains exclusively water, such as over an ocean, the value is '100.0'. Conversely, if the gridbox contains exclusively land, such as over a desert, the value is '0.0'.

RAIN GAUGE BIAS DATA FILE

File Size: 259200 bytes
File Structure: One record
Record Size: One 2-dimensional, 4-byte floating-point array of dimension (lat,lon)

lat: [1 - 180]

1 degree latitude gridboxes starting at 90 degrees south and extending to 90 degrees north; the center of the starting gridbox is 89.5 degrees south

lon: [1 - 360]

1 degree longitude gridboxes starting at the international date line and extending eastward back around to the international date line; the center of the starting gridbox is 179.5 degrees west

The data consist of a multiplicative correction factor that is multiplied with the regridded GPCC or CAMS rain gauge data to remove the known climatological biases in the rain gauge data due to wind effects, evaporation, and snow undercatch. The array contains a fill value of -1.0 when no rain gauge bias is available.