FIRE Cirrus 2 Readme

1.0 Introduction

This file contains information about the First ISSCP Regional Experiment (FIRE) Cirrus 2 sample read software and data files. These are the data sets that are available through the Langley DAAC:

- FIRE_CI2_CITATN_1HZ
- FIRE_CI2_CITATN_PMS
- FIRE_CI2_CLASS_SONDE
- FIRE_CI2_CSU_PRT6
- FIRE_CI2_CSU_SONDES
- FIRE_CI2_CSU_STN1
- FIRE_CI2_CSU_STN2
- FIRE_CI2_CSU_WNDPRFS
- FIRE_CI2_DOPLR_LIDAR
- FIRE_CI2_ER2_MAS
- FIRE_CI2_KINGAIR
- FIRE_CI2_LARC8_LIDAR
- FIRE_CI2_MAPS
- FIRE_CI2_NOAA_WNDPFS
- FIRE_CI2_NWS_IN_SND
- FIRE_CI2_NWS_OUT_SND
- FIRE_CI2_PAMS
- FIRE_CI2_RAMAN_LIDAR
- FIRE_CI2_SABRELINER
- FIRE_CI2_SKYCAMERA
- FIRE_CI2_SPECT_SIRIS

The read software is provided for sixteen FIRE Cirrus 2 data sets. Among these data sets, two aircraft data sets (i.e., KINGAIR, and SABRELINER) are in binary format, one in National Center for Supercomputing Applications' (NCSA) HDF netCDF format, and the others are in ASCII format. The 13 ASCII data sets are divided into six groups: sondes, surface observations, lidar, wind profiles, models, and aircraft. The groupings of the data sets closely follow the FIRE Cirrus 2 granules conventions. This "readme" file includes the following four other sections:

- Section 2.0 - describes all sample C programs (source files).
- Section 3.0 - discusses how to create the executables from the C program(s).
- Section 4.0 - demonstrates how to invoke the run-time executable(s).
- Section 5.0 - provides general information on the data sets.
- Section 6.0 - provides more detailed implementation notes.

If users have questions while using the FIRE Cirrus 2 sample read software, please contact the Langley Science Data and User Services (UDS) office. The UDS may be reached by E-Mail: userserv@eosdis.larc.nasa.gov, by telephone at (804)864-8656, or by FAX at (804)864-8807. The SUDS mailing address is:

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2.0 Read Software Files

The sample read programs for FIRE Cirrus 2 data sets are primarily developed in C language. Some data sets also have sample Fortran read programs. These C programs have been tested on the 'Sun4' and 'HP' Unix-based workstations. All library functions in the C source codes are tested for ANSI C conformance. Because some data sets can share the same C read program, there are less C programs than the number of data sets. A total of four different files are needed to generate the executable file(s) for one, many, or all of the 15 data sets. A 'Makefile' (called Makefile.fci2) is included for the convenience of creating the executable files from the C source files. These files and their purposes are listed as follows:

- **Makefile.fci2** - contains a set of commands to build the run-time executables.
- **genpro.c** - reads GENPRO formatted data, i.e., Kingair and Sabreliner data sets.
- **fci2_sw.c** - contains the sample read routines for all FIRE Cirrus 2 data sets in ASCII format. The functions in this C program are named closely after the applicable data sets.
- **fci2_lib.c** - has a collection of library routines that are used by more than one read routines in the fci2_sw.c file.
- **fci2_sw.h** - defines constants and data structures used in the read routines for the ASCII data sets.
- **fhdf_netcdf.c** - reads the FIRE HDF formatted files that were written using the netCDF extensions
- . **mas_read_netcdf.c** - reads the FIRE HDF formatted files that were written using the NetCDF extensions. This is the C version of the read software.
- **mas_read_netcdf.f** - reads the FIRE HDF formatted files that were written using the NetCDF extensions. This is the FORTRAN 77 version of the read software. This code is also available from the data producer's home page. The URL is http://ltpwww.gsfc.nasa.gov/MODIS/MAS/sw.html.
- **mas_read_netcdf.i** - is the include file to be used with the FORTRAN 77 version of the read software for the program called mas_read_netcdf.f (listed above).This code is also available from the data producer's home page. The URL is http://ltpwww.gsfc.nasa.gov/MODIS/MAS/sw.html.

In addition to these files, there are 11 individual C programs in the same directory. These C programs together can perform the functions of the above two files: fci2_sw.c and fci2_sw.h. Each C program is a complete read program for one ASCII data set. Among the sondes data group, nws_in_sonde, and nws_out_sonde data sets have the same data and record organizations, hence, one C program is provided to read both data sets. Among the surface observations data group, csu_station1 and csu_station2 data sets have the similar variables, one C program is provided to read these two data sets. These files and their applicable data set(s) are listed in Table 1. Individual C Program and its Data Set(s).

TABLE 1. Individual C Programs and its Data Set(s)

C File Name	Executable File Name[a]	Applicable Data Sets
class_sonde.c	class_sonde	FIRE_CI2_CLASS_SONDE
csu_prt6.c	csu_prt6	FIRE_CI2_CSU_PRT6
csu_sondes.c	csu_sondes	FIRE_CI2_CSU_SONDES
csu_station.c	csu_station1, csu_station2	FIRE_CI2_CSU_STN1 and FIRE_CI2_CSU_STN2
csu_wndprfl.c	csu_wndprfl	FIRE_CI2_CSU_WNDPRFS
doplr_lidar.c	doplr_lidar	FIRE_CI2_DOPLR_LIDAR
maps.c	maps	FIRE_CI2_MAPS
noaa_wndprfl.c	noaa_wndprfl	FIRE_CI2_NOAA_WNDPFS
nws_sonde.c	nws_sonde	FIRE_CI2_NWS_IN_SND and FIRE_CI2_NWS_OUT_SND
pams.c	pams	FIRE_CI2_PAMS
raman_lidar.c	raman_lidar	FIRE_CI2_RAMAN_LIDAR
mas_read_netcdf.c	mas_read_netcdf_c	FIRE_CI2_ER2_MAS
mas_read_netcdf.f	mas_read_netcdf_f	FIRE_CI2_ER2_MAS

a. These C executable file names are defined in the file ‘Makefile’. Users can change the name in the Makefile or during compilation to create different executable file names.

3.0 Creating C Executable Files

The user can have two ways of building the sample read program for one or multiple data sets from the C source files. One is using the ‘make’ command with the file ‘Makefile’, which requires the five files listed in Section 2.0. The other is using the C compiler ‘cc’. Section 3.1 illustrates the first method, and Section 3.2 illustrates the second method. The first method is simpler to use than the second one. The symbol ‘%’ in this section stands for Unix command line prompt.

3.1 Create with 'make' command

To build the executable read programs for the FIRE Cirrus 2 data sets which require specialized software type

% **make -f Makefile.fci2 all**

It will produce 15 executable files for all 13 FIRE Cirrus 2 ASCII data sets (i.e., data sets listed in Table 1. column 3), two executable files for Kingair and Sabreliner data sets, and one executable file for the FIRE CI2 ER2 MAS data set. If by chance, the file Makefile.fci2 was renamed to the default file name of "Makefile" or "makefile," the following command compiles all code to create executables for each read program.

% make all

To build the individual read program(s) for one or multiple FIRE Cirrus 2 data set(s), at the command line prompt, type

% **make data_set_name(s)**

where **data_set_name(s)** is one or more of the executable file name(s) in Table 1. column 2 plus ci2_kingair and ci2_sabreliner. This command will produce the executable file(s) for the **data_set_name(s)**. If using the makefile to compile the **mas_read_netcdf_c** read program on a SUN Solaris system, remove the "$(TARGET_ARCH)" from the LINT.c, LINK.c, and COMPILE.c lines to avoid compile option conflicts.

3.2 Create with C compiler 'cc'

This method uses the combinations of library source file fci2_lib.c, and a C source file (i.e., either genpro.c or one of C file(s) in Table 1. column 1). The include file fci2_sw.h should also be in the same directory. To build the executable file for csu_sondes data set from the csu_sondes.c source file, type

% **cc -o csu_sondes csu_sondes.c fci2_lib.c**

Every C executable file in the Table 1. column 2 can be built the same as csu_sondes except for csu_station1 and csu_station2. Since one C program is used to produce two executable files, a minus D option (-D) needs to be defined for the C preprocessor when compiling for csu_station1 data. For example, to build the executable for csu_station1 data set, type

% **cc -DHPUX[1] -DSTATION1 -o csu_station1 csu_station.c fci2_lib.c**

1. Because some unix systems do not support math functions nint(), and this function is needed in csu_prt6 and csu_station source files, a C preprocessor parameter (i.e., -DHPUX) is used when building the program. Therefore, to build the executable for csu_prt6 data set, type

% cc -DHPUX -o csu_prt6 csu_prt6.c fci2_lib.c and, to build the executable for csu_station2 data set, type

% **cc -DHPUX -o csu_station2 csu_station.c fci2_lib.c**

Similarly, to build the ci2_kingair for Kingair data set from one source file genpro.c, type

% **cc -DF2_KINGAIR -o ci2_kingair genpro.c fci2_lib.c**

And, type the following to create ci2_sabreliner for Sabreliner data set

% **cc -o ci2_sabreliner genpro.c fci2_lib.c**

NOTE that the details of C preprocessor options are handled in the Makefile under the first method. One read routine is used for FIRE Kingair and Sabreliner GENPRO formatted data sets. But the FIRE Cirrus 2 Kingair data set has an extra padding of 4 bytes after every three logical records, the preprocessor option (-DF2_KINGAIR) is needed to skip the four bytes every three logical records.

To use the command line to compile the FIRE_CI2 _ER2_MAS read software, it is recommended the user set environment variables to specify command line definitions, required HDF libraries, and include directories. This would decrease the amount of typing for the user every time the read software has to be recompiled. To set the environment variables, type:

% setenv INCLUDE_DIR "-I/usr/local/hdf-3.3r4/mfhdf/libsrc -I/usr/local/hdf-3.3r4/mfhdf/port -I/usr/local/hdf-3.3r3/hdf/include"

% setenv LIB_DIR "-L/usr/local/hdf-3.3r4/mfhdf/libsrc -lnetcdf /usr/local/hdf-3.3r4/hdf/lib/libdf.a"

NOTE: *Please make sure that you set the correct path for these include files and libraries before compiling this program.*

To build the executable for the FIRE_CI2_ER2_MAS type:

% cc $INCLUDE_DIR -DNO_HAVE_PROTOTYPES -DNO_STDARG mas_read_netcdf.c $LIB_DIR

NOTE: The ANSI Version of the C compiler (acc) was used to compile this Version of the HDF Library (3.3r4). If you compile source code that accesses the HDF compiler of older versions, the other versions of the C compiler (cc) can be used.

4.0 Invoking Read Software

This section illustrates the invocation of the executable files. Section 4.1 describes how to run read programs for the ASCII data sets. Section 4.2 describes how to run read programs for two aircraft data sets (in binary). Section 4.3 describes how to run the read program for the HDF data sets with the netCDF extensions.

4.1 Running Read Programs for the ASCII Data Sets

All executable files for FIRE Cirrus 2 ASCII data sets can accept multiple data files as the arguments. With the exception of doplr_lidar, all output are sent to the standard output device (i.e., stdout). Or, the output can be sent to a file with the Unix redirection command. The doplr_lidar has two parts of data: profiles directory and the profiles records. The profiles directory data are written to the stdout, but the profiles records are written to a file[2]. For all data sets, any error in reading the data will be written to the standard error device (i.e., stderr). The following example illustrates how to invoke ‘pams’ to read three data files.

% **pams st6nov18.data st1nov17.data st4dec07.data**

will read and print out the contents of three files, i.e., st6nov18.data, st1nov17.data, and st4dec07.data, to the stdout. The invocation of the read program for FIRE Cirrus 2 ASCII data sets are the same except for the maps data set. The maps executable provides an additional capability to allow users the option to specify printing of the min. max. values of the terrain data and all variables’s latitude and longitude data. For example,

% **maps ci2_maps_911124_03 ci2_maps_911118_00**

% **maps -s ci2_maps_911124_03 ci2_maps_911118_00**

the first one will read and print out the contents of two files, i.e., ci2_maps_911124_03, and ci2_maps_911118_00. The second one will prompt the user to enter the file names of the terrain and latitude/longitude data. After the user enters the file names, it will print out the min. max. values of the terrain and latitude/longitude data and the contents of two data files “ci2_maps_911124_03” and “ci2_maps_911118_00”.

4.2 Running Read Programs for the Binary Data Sets

Currently, the executable files for Kingair and Sabreliner aircraft data sets can run one data file at each invocation. The aircraft data files are organized in pairs, i.e., one header file has a corresponding flight data file. In order to process the data file accurately, the header file needs to be specified as an argument preceding the data file argument. For example, if the Kingair data file **ci2_ka_flt01_911109**.dat is to be processed, and its corresponding header file is **ci2_ka_flt01_911109**.hdr, then type

% **ci2_kingair ci2_ka_flt01_911109.hdr ci2_ka_flt01_911109.dat**

will read the binary data in RF01.dat and send the output to the standard output device. The output can be sent to a file by typing

2. The output file is automatically generated with the name containing the input file name plus the process id as the file name extension. Because the process id for each invocation of the executable is different under Unix system, the output file name will be different at each run. If for some reason the output file can not be created, the output will be sent to the standard output device.

% ci2_kingair ci2_ka_flt01_911109.hdr ci2_ka_flt01_911109.dat > any_file_name

See Section 5.6 IMPLEMENTATION NOTES for the data output.

4.3 Running the Read Program for the FIRE_CI2_ER2_MAS Data Set

Currently, the executable mas_read_netcdf.c read program (C version) for the FIRE_CI2_ER2_MAS data set does not accept command line arguments. When this program is executed, it requests an input filename. The output filename is automatically created by appending ".rpt" to the input file name. After entering the filename, the user is presented with a parameter selection list. Upon completing the parameter selection process, the user is provided the option of including the global parameters in the report file. At this point, the program generates the report file and exits. The following line will begin program execution:

% mas_read_netcdf_c

A sample of the interactive program execution is provide in Section 6.0.

5.0 Data Sets Information

There are six subsections describing each data set group. Each subsection is further divided into subsection(s) to contain descriptions of each data set. The data sets information are obtained from the text file or documents, from the data producer, or embedded metadata information in the data files. The high-level data set descriptions, the data files, the variables in the data files, and the contacts for data production are given under each data set. Some data sets contain the responses from the data producer to answer questions on the data contents. These questions/responses are collected under the data notes.

5.1 SONDES

There are four sondes data sets in FIRE Cirrus 2 data: class_sonde, nws_in_sonde, nws_out_sonde, and csu_sondes. Among them, nws_in_sonde, and nws_out_sonde data sets have the same variables, hence, they are described in one subsection.

5.1.1 CLASS_SONDE

NCAR class_sonde data were collected during November and December of 1991. Sounding files for CaPE from Melbourne and Cape Canaveral AF Base, and Orlando are not supported by NCAR. Note that among the three versions of a given sounding that NCAR class data have, Langley DAAC has only "i" version, which is the sounding data with data interpolated to every 5mb level. NCAR class data can be accessed by the ATD SUDS software (SUDS runs on UNIX machines in an X-window environment).

FILES:

NCAR class sonde data consist of 29 granules. The granule is named ci2_XXX_date, where XXX is the site id, and date the temporal coverage of the collected data. Each granule has multiple ASCII data files. The date and time of the soundings have been coded into the file names. Each class sonde file is named ‘imddhhMM.sta’, where m is the month (values [1-9, a-c]; b=Nov), dd the day of month, hh the hour sounding start (GMT was used for CaPE), MM the minute for sounding start (hhMM is approximate), and sta the 3-letter station ID.

The first 12 lines in a data file contain header information, followed by the three-line variables headings, followed by the class sonde records.

VARIABLES:

Each record contains 21 variables. Variables are separated by white space(s). These variables with their units are listed in order below.

	Variable Name
1.	Time into launch (minutes)
2.	Pressure (mb)
3.	Temperature (C)
4.	Dewpt - dewpoint temperature (C)
5.	RH - relative humidity (%)
6.	Uwind (m/s)
7.	Vwind (m/s)
8.	Wspd - wind speed (m/s)[3]
9.	Dir - wind direction (degrees)
10.	dZ (m/s)
11.	Longitude (degrees)
12.	Latitude (degrees)
13.	Range (km)
14.	Angle (degrees)
15.	Altitude (m)
16.	Qp (mb)
17.	Qt (c)
18.	Qh (%)
19.	Qu (m/s)
20.	Qv (m/s)
21.	Quv (m/s)

NOTES ON DATA

Some data files have a negative number for the first time entry, and in the first row of data the variables, Qt, Qp, Qh, Qu, Qv, and Quv all have the value 77.00. Also, the latitudes and longitudes after the first row are all zeros. The answers from Dave Starr (starr@climate.gsfc.nasa.gov) about the above questions are listed as follows.

3. The wind speed data for Orlando are stated as being in m/s, as are the Uwind and Vwind components. However, it is possible that the wind speed is actually in *knots*, since the wind speed value tends to be too great, given the u and v components.

1) Data in the first row are surface conditions obtained from the PAMS (Portable Automated Mesoscale Station) station observations and not the CLASS sonde itself. These are pre-launch surface conditions. The negative time may indicate how long before the sonde release (at time = 0) the PAMS data were taken. (PAMS data were automatically telemetered to NCAR and then incorporated into CLASS sonde data processing.)

2) All the Q parameters are “quality indicator” parameters. They are computed based on the local standard deviation of the relevant actual data quantity (e.g., Qp is for the pressure observations) over the “local smoothing window” used. They are not really relevant to the surface observations and I doubt that the 77’s have much meaning for the surface level. Note that the CLASS data were actually sampled at about a 2-second interval (about 10 meters in height) while the 5-mb product has about a 50-100m resolution in the troposphere. NCAR typically uses a 20-second local window for smoothing, quality control, etc.

3) The latitudes and longitudes after the first row are all zeros are a test sounding that did not have any winds. Without any winds, there are no locations given above the surface level. Try another sonde further into the data set and you will most likely find locations given at levels above the surface.

CONTACTS FOR DATA PRODUCTION INFORMATION

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5.1.2 NWS_IN_SONDE & NWS_OUT_SONDE

The nws_in_sonde and nws_out_sonde data sets were collected at various stations. The nws_in_sonde data were collected for the period from Nov. 13, 1991 to Dec. 7, 1991. The nws_out_sonde data were collected from Nov. 20, 1991 to Dec. 7, 1991. Both have the same file and record organizations, and contain the same variables. Thus, these two data sets share the same read routine to retrieve the records.

FILES:

The nws_in_sonde data set consists of 17 granules. The nws_out_sonde data set consists of 31 granules. Each granule is named ci2_XXX_yym1d1_m2d2, where XXX is the 3-letter station name, m1d1 the beginning month and date, and m2d2 the end month and date of the data. Each granule has multiple ASCII data files. Each file is named XXX.nnnn, where XXX is the same 3-letter station name as the granule, and ‘nnnn’ the ascent number. The first ten lines in a data file contain header information, followed by two-line variables heading, followed by the NWS sondes records. The Fortran format for the variables is: (3x, f7.2, f8.3, f6.1, 2(f7.2), 2(f6.1), f9.4, 2(f7.2), 4(f6.1), f8.0, 2(f7.2), 2(f8.3), 2(f9.4)).

VARIABLES:

Each record starts with the number of level, followed by 21 variables, and ends with the same number of level. Variables are separated by white space(s). These variables with their units are listed in order below.

Variable Name

1. time into launch (minutes)
2. height (km)
3. pressure (mb)
4. temperature (C)
5. theta - potential temperature (K)
6. rh - relative humidity with respect to water (percent)
7. rh - relative humidity with respect to ice (percent)
8. sphum - specific humidity (g/kg)
9. dewpt - dewpoint temperature (C)
10. frstpt - frost point temperature (C)
11. speed - wind speed (m/s)
12. direc - wind direction (degrees)
13. u - zonal component of wind (m/s)
14. v - meridians component of wind (m/s)
15. ascent - ascent rate (m/min)
16. lapse - lapse rate (C/km)
17. dtheta - potential temperature lapse rate (K/km)
18. x - longitudinal distance of sonde with respect to point of origin (km)
19. y - latitudinal distance of sonde with respect to point of origin (km)
20. lat - latitudinal position of sonde (degrees N)
21. long - longitudinal position of sonde (degrees W)

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5.1.3 CSU SONDES

The CSU sonde data were generated in support of the FIRE Phase II Cirrus observation field experiment held in Coffeyville, Kansas during the period from 13 November to 06 December 1991 at the Parsons KG&E Power Plant. The data covered at 37 deg 18 min N and 95 deg 07 min W, with a vertical resolution usually of roughly 5-10 m. They were provided to allow a calculation of an approximate location of the sonde.

FILES:

CSU sondes data set includes 16 granules. Each is named ci2_par_yymmdd. Each granule has one or multiple ASCII data files with the name ‘yymmdd.hhMM’, where yy is the year, mm the month (only 11 and 12 are valid), dd the day, and hhMM the hour and minute when the data were collected. Data points with values of -9999 are considered bad.

VARIABLES:

There are 10 variables in a record; variables are separated by white space(s). The Fortran 77 format for these variables is: (3I3,F6.2,6F10.3). These variables with units and estimated precision (in units) are listed in order below.

	Variable Name	Precision	Min	Max
1.	julian day (UTC)	0.0001157	1	365
2.	hour (UTC)	1	0	23
3.	minute (UTC)	1	0	59
4.	second (UTC)	0.01	0	59.99
5.	geopotential height (km)	0.01	0	50
6.	pressure (mb)	1	5	1050
7.	temperature (K)	0.5	183	323
8.	relative humidity (%)	3	5	100[4]
9.	azimuth angle (deg)	0.5	0	360[5]
10.	elevation angle (deg)	0.5	-90	90

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5.2 SURFACE OBSERVATIONS

There are four data sets in this group: csu_prt6, csu_station1, csu_station2, and pams. They are described in the following four subsections.

5.2.1 CSU_PRT6

The csu_prt6 radiometer data set was produced by the ASD of CSU in support of the FIRE Phase II Cirrus Intensive Field Observations (IFO) conducted in Coffeyville, Kansas. The csu_prt6 data were collected during the period from 18 Nov 1991 (day 322) to 07 Dec 1991 (day 341) at the Parsons KG&E Power Plant, Parsons, Kansas (37 deg 18 min N and 95 deg 07 min W). The PRT-6 is an all-purpose chopped bolometer. It was operated with a 2 degree field of view pointing vertically upward. The filter employed narrowed the spectral band to range from about 885 to 945 inverse centimeters (the infrared window region). The PRT-6 was not run in a continuous mode. When operating, data were sampled every 5 seconds. NOTE that there were temporal gaps in the data.

4. A humidity of 20% is often observed as a minimum value, especially at low pressures and cold temperatures.

5. Because of problems tracking the sonde, the angles of the tracking antenna should be used with caution. This precision number is only under IDEAL conditions. Precision varied.

FILES:

The csu_prt6 data set includes 15 ASCII data files. They are named 'ci2_prt6_yymmdd', where yy is the year, mm the month (only 11 and 12 are valid), and dd the day when the data were collected.

VARIABLES:

There are four variables in a record; variables are separated by white space(s). These variables with units and estimated precision (in units) are listed in order below.

	Variable Name	Precision	Min	Max
1.	julian day (UTC)	0.0001157	1	365
2.	hour-minute (UTC)	1	0	2359
3.	second (UTC)	0.1	0	59.9
4.	equivalent brightness temperature (K)	1	150	300

CONTACTS FOR DATA PRODUCTION INFORMATION

Same as the CSU sondes contact.

5.2.2 CSU_STATION1:

The csu_station1 surface radiation data set was produced by the ASD of CSU in support of the FIRE Phase II Cirrus IFO conducted in Coffeyville, Kansas. CSU Station 1 point data were collected every 2 minutes for the period from 11 Nov 1991 (day 315) to 8 Dec 1991 (day 342) at the Parsons KG&E Power Plant Parsons, Kansas (37 deg 18 min N and 95 deg 07 min W). NOTE the 2 minute values were instantaneous readings.

FILES:

The csu_station1 data set comprises 29 ASCII files. Each file is named 'ci2_s1kge_yymmdd', where yy is the year, mm the month, and dd the day when the data were collected. Missing data and extreme values are marked with -9999.0.

VARIABLES:

A total of 19 variables in a record; variables are separated by white space(s). These variables with units and estimated precision (in units) are listed in order below.

	Variable Name	Precision	Min	Max
1.	time (fraction of julian day, UTC)	0.0001157	1	365
2.	wind speed (m/s)	0.5	0	100
3.	wind direction (degrees)	5.0	0	360
4.	temperature (C)	0.2	-40	40[6]
5.	relative humidity (%)	5.0	0	100

6. Some relative humidity data have values above 100%, but within the precision of the instrument and data. Other variables may have similar values exceeding the min/max limits.

6.	solar total irradiance (W/m2)	5.0	0	1500
7.	near infrared irradiance (W/m2)	5.0	0	1500
8.	infrared irradiance (W/m2)	5.0	0	600
9.	dome temperature (K)	0.2	233	313
10.	sink temperature (K)	0.2	233	313
11.	direct solar - yellow filter (W/m2) [20 sec]	5.0	0	1500
12.	direct solar - red filter (W/m2) [43 sec]	5.0	0	1500
13.	direct solar - dark red filter (W/m2) [67 sec]	5.0	0	1500
14.	direct solar - no filter (W/m2) [90 sec]	5.0	0	1500
15.	direct solar - no filter (W/m2) [20 sec]	5.0	0	1500
16.	direct solar - no filter (W/m2) [43 sec]	5.0	0	1500
17.	direct solar - no filter (W/m2) [67 sec]	5.0	0	1500
18.	direct solar - no filter (W/m2) [90 sec]	5.0	0	1500
19.	hour-minute (hhmm UTC)	0.16667	0	240

NOTE: Variables 14 and 18 have the same name. The data producer explained as follows: There were two pyrheliometers tracking the sun; one had a filter wheel and the other did not. The two identical variables are different because they come from 2 different pyrheliometers though they are measuring the same thing at the same time. The second variable is the non-filtered pyrheliometer.

INSTRUMENTATION:

- Campbell data logger -- time, hour-minute
- R.M. Young Wind Sensor -- wind speed and direction
- Campbell Model 207 Probe -- temperature and relative humidity
- Eppley Pyranometer -- solar total and near infrared irradiance (.28-2.8 microns)
- Eppley Pyrgeometer -- infrared irradiance (4-50 microns), and dome and sink temperatures
- Eppley Pyrheliometer -- direct solar irradiance (10 deg fov (no filter -- .28-2.8 microns; yellow filter -- .55-2.8 microns; red filter -- .695-2.8 microns; dark red filter -- 1.0-2.8 microns))

CONTACTS FOR DATA PRODUCTION INFORMATION

Same as the CSU sondes contact.

5.2.3 CSU_STATION2:

The csu_station2 surface radiation data set was collected every 2 minutes for the period from November 13 through December 8, 1991 at Tri-City Airport, Parsons, Kansas, 37 deg 20 min N, 95 deg 30 min 30 sec W. NOTE the 2 minute values were instantaneous readings.

FILES:

The csu_station2 data set consists of 26 ASCII files. Each data file is named 'ci2_s2tri_yymmdd', where yy is the year, mm the month, and dd the day when the data were collected. Missing data and extreme values are marked with -9999.0.

VARIABLES:

A total of 11 variables in a record; variables are separated by white space(s). These variables with units and estimated precision (in units) are listed in order below.

	Variable Name	Precision	Min	Max
1.	time (fraction of julian day, UTC)	0.0001157	0	367
2.	wind speed (m/s)	0.5	0	100
3.	wind direction (degrees)	5.0	0	360
4.	temperature (C)	0.2	-40	40
5.	relative humidity (%)	5.0	0	100[7]
6.	solar total irradiance (W/m2)	5.0	0	1500
7.	near infrared irradiance (W/m2)	5.0	0	1500
8.	infrared irradiance (W/m2)	5.0	0	600
9.	dome temperature (K)	0.2	233	313
10.	sink temperature (K)	0.2	233	313
11.	hour-minute (hhmm UTC)	0.16667	0	2400

INSTRUMENTATION:

The csu_staion2 instruments include all but the Eppley Pyrheliometer as in the csu_station1 instruments.

CONTACTS FOR DATA PRODUCTION INFORMATION

Same as the CSU sondes contact.

5.2.4 PAMS

The pams data set was taken during the FIRE Cirrus 2 Experiment from the period 13 Nov 1991 to 07 Dec 1991 at six sites. Since FIRE Cirrus 2 Experiment was approximately 25 days long, there were 25 data files for each of 6 sites where PAMS data were collected.

FILES:

The pams data set consists of 6 granules which represents 6 sites. Each granule is named ci2_pamX_911113_1207, where X is the site number, 91 the year, 1113 the beginning date, and 1207 the end date. Each granule has 25 ASCII files. Each file is named 'stXmmmdd.data', where X is the same site number as in the granule, mmm (either nov or dec) the month, and dd the day of the data being collected. Each file starts with a header line, followed by 1440 data records. Missing value code is -99.00 for all parameters. The Fortran format for the header line is: (a8,i2,2x,3(i2),3(f10.4)), and the Fortran format for the variables is: (i4,2x,12(f7.2,1x),2x,12(i2))

VARIABLES:

Each record has an observation # (record #), 12 variables, and 12 quality flags (QA)[8] for each of the 12 variables. These variables with the units are listed in order below.

7. Some relative humidity data have values above 100%, but within the precision of the instrument and data. Other variables may have similar values exceeding the min/max limits.

Variable Name

1. pressure (mb)
2. temperature (C)
3. wet bulb temperature (C)
4. relative humidity (percent)
5. mixing ratio (g/kg)
6. potential temperature (K)
7. u-wind component (m/s)
8. v-wind component (m/s)
9. avg. wind speed (m/s)
10. wind direction (degrees)
11. maximum wind speed within the minute (m/s)
12. downward solar irradiance (W/m**2)

CONTACTS FOR DATA PRODUCTION INFORMATION

Same as the NWS_IN_SONDE contact.

5.3 LIDAR

There are three data sets in this group: doppler lidar, larc8_lidar, and raman_lidar. Since larc8_lidar data are image data, it is not described here. The doppler lidar data set is described in subsection 5.3.1, and the raman lidar data set is described in subsection 5.3.2.

5.3.1 DOPPLER LIDAR

The doppler lidar data set included wind profiles derived by the VAD method for the FIRE Cirrus 2 top 5 priority days (21, 25, 28, 30 of Nov 1991, and Dec. 5, 1991). The doppler lidar experiment objective was to obtain lidar measurements of relative backscatter signal intensity and radial velocity from cirrus clouds to study their microphysical and radiative properties. This data set provides Vertical profiles (approx. 1.5 - 20.0 km AGL) data.

FILES:

This data set comprises six ASCII files in tabular format. Five of them are named 'fire2vadDDMMMa', where DD is the day of month, MMM the month (either nov or dec), and 'a' indicating ASCII file. The sixth file is named 'fire2vad91a', which contains the entire year 1991's data. Each ASCII file is derived from two corresponding binary files, i.e., directory and

8. The 12 quality flags for the 12 variables have one of the five values (0, 2, 7, 8, and 9). These values meanings are:

NCAR derived variable quality flags values are: 0 = good datum
2 = outlier (possible bad data)
9 = missing or bad datum

D. Starr and D. Case's derived parameter quality flags values:
0 = good datum (let NCAR flag remain the same)
8 = suspected spurious data that NCAR flagged as a good datum
7 = suspected spurious data that NCAR gave a QA of 2 (this QA # has only been applied to solar irradiance data)

data files. Thus, an ASCII file contains the directory of all profiles in this file and the profiles data. Each profile starts with one directory line, followed by two header lines, followed by multiple profile records.

VARIABLES:

There are 12 variables in the directory section, and nine variables in a profile record. The Fortran format for the directory variables is: (I5, 2I8,3(F8.2),4I4,2I6), and format for the profile variables is: (7(F9.3), I4,x,F9.3). The variable values in the directory line should be the same as the corresponding line defined in the directory of profiles section. The variables for the directory and the profile record are listed in order below.

Variable Name (for directory)

1. profile number
2. date
3. time
4. elevation angle
5. begin azimuth
6. end azimuth
7. sweep number
8. sweep direction
9. quality flag
10. site number
11. begin record number in data file
12. end record number in data file

Variable Name (for profile record)

1. altitude (km above ground level)
2. wind speed (m/s)
3. wind direction (degrees)
4. signal to noise ratio
5. percent of good points (%)
6. rms error
7. vertical velocity divergence (m/s)
8. quality of each data value
9. energy at each altitude.

INSTRUMENTATION

The doppler lidar is a pulsed, CO2, coherent, mobile laser radar system. Although the principal wavelength of operation is 10.6 micrometers, any wavelength between approximately 9 and 11 micrometers may be used. The lidar system scanning capability includes elevation angles ranging from -5 through 90 degrees and full azimuth sweeps of 0 through 360 degrees. A profile is sampled at every 1/2 hour during intensive mode, and at every 2 hours during monitoring mode.

CONTACTS FOR DATA PRODUCTION INFORMATION

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5.3.2 RAMAN_LIDAR

GSFC raman_lidar water vapor mixing ratio (wvmr) data with altitudes and times were collected for the period from 13 Nov 1991 to 07 Dec 1991. Each night consists of a series of one minute profiles. Data is summed for one minute in the detectors and saved to a file. For the 10 minute averaged data, the data is summed for 10 minutes before the calculations are performed. Each profile has 75 meter resolution from 0.4135 to 10.299 kilometers. Zero (0) km means sea level. The site altitude is 0.229 km and the first data point is at 0.1845 km above ground level.

FILES:

Raman Lidar data set consists of 28 ASCII files. Each is named ci2_wvYYMMDD_Xm, where YY is the year, MM the month, and DD the day when the data were collected. X in the file name can only be either 1 or 10, indicating the 1 minute summed data or 10 minutes averaged data. Each file starts with two header lines. The first header line contains the beginning and ending time, which have the format of YYYYMMDDhhmmss, where YY is the year, MM the month, DD the day, hh the hour, mm the minute, and ss the second of data observed in this file. The second header line contains the description of viewing geometry in file and the range of the water vapor mix ratio. The next line is the “number of profiles” value, which can occur only once in each file. The “time of profile” and the “number of heights” follow immediately. If there are X “number of heights”, there will be X occurrences of the “height”, “water vapor mix ratio”, and “water vapor mix ratio error” lines following it. Then, the next “time of profile” follows. This repeats over the “number of profiles” times. Data with values of 0 (zero) are missing data.

VARIABLES:

There are six variables in the data. These variables with units and estimated precision (in units) are listed in order below.

	Variable Name	**Precision**	**Min**	**Max**
1.	num of profiles	1	1	710
2.	time of profile (ut-seconds)	60	0	86400
3.	number of heights (lines)	1	1	131
4.	height - altitude (meters)	75	10	75
5.	water vapor mix ratio (g/kg)	0	0	20
6.	water vapor mix ratio error (g/kg)	0	0	1

The wvmr error in the data is a function of altitude. The data is believed to be good up to 10.229 km MSL, which is all that is sent.

INSTRUMENTATION

The GSFC water vapor raman lidar uses an excimer (XEF) laser at 351 nm. The telescope filters out the laser wavelength and the raman shifted nitrogen, oxygen and water vapor wavelengths.

The water vapor to nitrogen ratio is used to calculate the water vapor mixing ratio. Profiles of data are collected every minute with a vertical spatial resolution of 75 meters. At start-up, all channels receive the same signal from the telescope to determine the relative sensitivity between channels. Then, the water vapor over nitrogen raman shifted signals are proportional to the water vapor mixing ratio. The water/nitrogen ratio is calibrated to radiosondes coincident during this time to determine the constant to convert the water/nitrogen ratio to water vapor mixing ratio.

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5.4 WIND PROFILES

There are two FIRE Cirrus 2 data sets in this group: CSU wind profiles, and NOAA wind profiles. They are described in subsection 5.4.1 and subsection 5.4.2, respectively.

5.4.1 CSU Wind Profiles

The CSU wind profiles data set was produced by the ASD of CSU in support of the FIRE Phase II Cirrus IFO conducted in Coffeyville, Kansas. The CSU wind profiles data were single cycle data collected for the period from 12 Nov 1991 to 7 Dec 1991 (day 342) at Parsons, Kansas (37 deg 18 min N and 95 deg 07 min W). This data had been through a quality control program using the Weber and Wuertz QC subroutines. Thresholds of 4m/s and 5% size of largest pattern was used on combined-low/high-mode-opposing-beams profile. Note that vertical velocity was assumed to be zero. (28% of the data was marked as “bad”.)

FILES:

The CSU wind profiles data consists of 26 granules. Each granule is named ci2_csuwnd_yymmdd. Each granule has one or multiple ASCII data files. The data file is named ‘yymmddhh.wp’, where yy is the year, mm the month, dd the day, and hh the hour the data were collected. Each file starts with a header line indicating the time, followed by the CSU wind profiles data. The header line has the format YYMMDDHH, where YY is the year, MM the month, DD the day, and HH the hour (UTC) of this data file. The Fortran format for the header is: (4I2).Data with values of -9999.0 in u-wind and v-wind are bad data.

VARIABLES:

There are four variables in the data; variables are separated by white spaces. The Fortran format for the data variables is: (I2,F7.3,2F10.3). These variables with units and estimated precision (in units) are listed in order below.

	Variable Name	Precision	Min	Max
1.	minute	1	0	59

2.	height (km above MSL)	n/a	n/a	n/a
3.	u-wind (m/s)	n/a	n/a	n/a
4.	v-wind (m/s)	n/a	n/a	n/a

CONTACTS FOR DATA PRODUCTION INFORMATION

Same as the CSU sondes contact.

5.4.2 NOAA Wind Profiles

The NOAA wind profiles data were collected during the period from Nov. 13, 1991 to Dec. 7, 1991. The original NOAA wind profiles data were stored in the Enhanced Binary Universal Form (EBUF) format. These data files were processed and provided in ASCII format by the Langley DAAC. The same data in EBUF format are available off-line. ***NOTE: The conversion program assumed that the height increment on the observation station remains the same in a wind profiles record***. The size of the ASCII NOAA wind profiles files range from 17 to 37 MB size. Expect to take a while to read the data.

FILES:

The NOAA wind profiles data set consists of 25 ASCII files. A NOAA wind profiles file has multiple wind profiles records. Each file is named ci2_noawnd_yymmdd_6m, where yy is the year, mm the month, and dd the day when the data were collected. A wind profiles record starts with three header lines, followed by three lines of column headings, followed by wind profile data, and ends with the parameter “Profiler in checkout mode flag” line. The first header line contains date and time values, the second header line contains station latitude and longitude values, and the third header line contains the values for the parameters “height of station above sea level” and “height increment”.

VARIABLES:

There are 10 variables in a NOAA wind profile record. Variables are separated by white space(s). The variable values are left-justified. These variables with their units are listed in order below.

	Variable Name	**Unit**
1.	Height above station	Meters
2.	Signal Power (0th moment) North	Decibels
3.	Signal Power (0th moment) East	Decibels
4.	Signal Power (0th moment) Vertical	Decibels
5.	Mean Velocity (1st moment) North	Meters/Second
6.	Mean Velocity (1st moment) East	Meters/Second
7.	Mean Velocity (1st moment) Vertical	Meters/Second
8.	Velocity variance (2nd moment) North	(Meters/Second)**2
9.	Velocity variance (2nd moment) East	(Meters/Second)**2
10.	Velocity variance (2nd moment) Vertical	(Meters/Second)**2

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5.5 MODELS

MAPS data set is the only one in this group.

5.5.1 MAPS

For FIRE Cirrus 2, the MAPS analyses were available every 3 hours for the period of 00Z Nov. 12, 1991 through 00Z Dec. 8, 1991. MAPS analyses generally were more accurate than the standard NMC analyses. However, some exceptions were discovered[9], which were due to computer, network, code failures, or missing data. See the file 'data_catalog_maps' for the temporal and spatial coverages information.

FILES:

Each MAPS analysis file contains 65250 lines and 7608900 bytes in ASCII format. The file naming convention for the MAPS analysis files is: ci2_maps_yymmdd_hh, where yy is the year, mm the month, dd the day, and hh the starting hour when the data were collected. Some of the MAPS data information files are listed below.

- data_catalog_maps - Verbose explanation of the MAPS data
- data_catalog_mapslatlon - Verbose explanation of the MAPS latlon file
- data_catalog_mapsterrain - Verbose explanation of the MAPS terrain file
- maps_extremes.list - List of min & max values (in integer values) for each variable in the MAPS data files
- mapsterrain.dat - The 2-D topography field describing the terrain height, which is not included in each MAPS data file
- mapsstat.dat - The statistical evaluation result of the MAPS analyses valid at 00Z and 12Z compared with NGM products, persistence and radiosonde data
- mapslatlon.dat - MAPS latitude and longitude data

MAPS uses an 81 (x direction) x 62 (y direction) horizontal Cartesian mesh with 60 km grid spacing on an Arakawa-A grid which has all variables defined at each grid node. The information for each horizontal field consists of a header line containing the name of the variable and the vertical coordinate, followed by 62 groups of 81 field values.

Each group of 81 field values represents one x direction row of grid node values, beginning with the southernmost row in the domain, and proceeding northward with succeeding groups. The 81 values are ordered from the west to the east edges of the grid domain, and are listed in the file using 13 numbers per line, with the last line in each group containing 3 values. There are 10 char-

9. See section 6.1 and 8.1 of the file 'data_catalog_maps' for the validity of the MAPS data.

acters per field value, and each value is right-justified with 3 decimal digits following an explicit decimal point, as in Fortran f10.3 format. Hence, the very first field value will be the pressure on the sigma=1 surface at the southwest corner of the domain. The very last field value will be the V wind component on the virtual theta=410K surface at the northeast corner of the domain.

VARIABLES:

Each MAPS data analysis file contains a sequence of two-dimensional horizontal fields for the 6 variables at the 25 vertical coordinates. The sequence for the vertical levels is: sigma = 1, 0.8, 0.6, 0.4, 0.2, 0.0, then virtual theta = 272, 280, 286, 292, 296, 300, 304, 308, 312, 316, 320, 325, 330, 335, 342, 350, 360, 380, and 410 K. These variables with units and the allowable min and max values are listed in order below.

	Variable Name	Min	Max
1.	Pressure (mb)	50	1500[10]
2.	Montgomery Streamfunction/g (m)	26000	4000
3.	Virtual Potential Temperature (Deg K)	250	420
4.	Condensation pressure (mb)	50	1400
5.	U-Wind (m/s)	-120	120
6.	V-Wind (m/s)	-120	120

NOTE: An iterative procedure is required to deduce the temperature and the mixing ratio from the virtual potential temperature and the condensation pressure since these MAPS variables are functions of both temperature and mixing ratio.

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5.6 AIRCRAFT

Aircraft data obtained during the FIRE Cirrus 2 experiment were classified according to the aircraft by which the measurements were taken. Two aircraft data sets are described here: Kingair, and Sabreliner. Although they have different sets of variables, they are generated with the same format. Thus, one C read source file is used to parse the format and interpret the data for both aircraft data sets.

10. Values of pressure and condensation pressure in excess of 1050 mb occur when the virtual potential temperature at a surface point is high (e.g. 300 K). The cooler virtual theta surfaces (e.g. 272 - 296) are therefore below ground, at higher pressure.

5.6.1 KINGAIR & SABRELINER

Kingair and Sabreliner data files for 1991 FIRE Cirrus 2 are provided by NCAR in GENPRO format (binary positive integers). The Kingair and Sabreliner data files are organized in pairs for an individual flight, i.e., header #1, flight #1 data, header #2, flight #2 data, etc... Header files are in ASCII format, and flight data are in binary format.

FILES:

Kingair data set has 15 header-data-file pairs for 15 flights. Sabreliner data set has 19 header-data-file pairs for 17 flights, among which flight 6 has three header-data-file pairs. Each flight is named ci2_aircraft_flt#_flighttime, where “aircraft” is either ‘kng’ or ‘sa’ to mean Kingair or Sabreliner, flight# is ranging from 01 to 15 for Kingair and 01 through 17 for Sabreliner (flight 6 numbers are 06a, 06b, and 06c), and “flighttime” has the format of yymmdd to indicate the date of the flight, e.g., ci2_kng_flt01_911109, and ci2_sa_flt02_911118. The flight name is the same as granule name. The header files are named granule_name.hdr, and the data files are named granule_name.dat for both aircraft data sets.

A header file contains the variable names (or called parameters), and the information regarding sampling rate, scale factors, data size, etc. for the parameters. The data file contains data values of parameters over a specified time period.

VARIABLES:

Each of the 15 Kingair data files has 144 variables, and each of 19 Sabreliner data files has 106 variables. Each variable is defined as a 4 bytes unsigned integer. The unsigned integer values have to be converted to real numbers for correct reading. Usually the variables are sampled at 1 Hz per second (per genpro cycle), but some variables are sampled at higher rate. The sample read routine automatically retrieves the information for all defined parameters, and interprets the binary data accordingly.

NOTES ON DATA

Questions about instrumentation and specific data parameters (including their derivation, utilization and units) should be directed to NCAR. There is one Kingair data file and one Sabreliner data file have small discrepancies between the header and the data beginning and ending times, and a negative time values on the last record. Larry Miloshevich from NCAR has the following response:

The time values were incorrect (negative) for the last few seconds of each flight, and there were beginning time and ending time discrepancies of a few seconds between the times listed in the file headers and the first or last times of the initial and final data records. My guess is that they are due to effects of turning the data system on and off, since the header time interval for the flight is slightly longer than the interval of data collection (i.e., perhaps time marks are recorded for the header when the data collection system is turned on or off, but if it takes a couple of seconds for the system to begin or quit taking data then the data collection interval will be slightly shorter). Also, my guess is that the negative time values at the end of files might be due to flushing data buffers when the system is shut down. In any case, the best advice for users of this data would be:

1) use the time values associated with the data records and ignore the discrepancy with the header files, and 2) eliminate or otherwise don't use the ending records with negative time values, since other data in those records may be untrustworthy.

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IMPLEMENTATION NOTES

The generic read program (genpro.c) for FIRE aircraft flight data extracts the flight date, flight start time, and flight end time from the header file (not from the data file) because FIRE-I Kingair flight data do not have the time variables (HR, MIN, SEC) defined as FIRE Cirrus 2 aircraft data. However, the minimum and maximum latitude and longitude values are obtained from the data file. The total number of records in the specified data files is printed out at the end of the output.

Because of the huge amount of data in the data file, the read program by default only prints out the selected 7 variables (1st, 2nd, 3rd, 4th, 5th, 6th, and 7th variables, in that order) of all records in tabular format. The "printf" statement in the C source file works as a demonstration of printing out values of the desired variables. If all data values are to be printed out, users should recompile the genpro.c program with a "-DDEBUG" preprocessor option and rerun the executable. The minus D option will produce the values of all variables for all records in the specified data file.

5.7 HDF with netCDF Extensions

This data set was written in NCSA's HDF netCDF format. The data files are organized by date of flight and straight line flight track.

5.7.1 FIRE_CI2_ER2_MAS Data Set

LONG NAME FOR THIS DATA SET:

First ISCCP Regional Experiment (FIRE) Cirrus 2 NASA ER-2 Moderate Resolution Imaging Spectrometer (MODIS) Airborne (MAS) Data (FIRE_CI2_ER2_MAS)

FILES:

FIRE_CI2_ER2_MAS data set files are prefixed with "ci2_mas_" the indicate they belong to this data set. This is followed by a six digit number (yymmdd) that represents the year, month and day the data was collected. The name ends with a period, '.', followed by a three digit number which indicates which flight line is contained within the file.

VARIABLES:

Both data sets contain 34 global attributes and 37 scientific data sets (i.e., variables) per data file.

The global variable names are:

title
CreationDate
ExperimentName
FlightDate
FlightNumber
ClockUsedToProcess
FlightLineNumber
TotalFlightLines
Credits
MASDataUsersGuideSource
ClockProblemDescription
FIREClockOffset(INS-MAS)Hours
VIS/NIRCountSensitivityAdjustment
SoftwareVersion
CalibrationVersion
data_set
data_product
geog_flag
day_night_flag
granule_version
metadata_version
producer_granule_id
data_quality
granule_size
begin_date
end_date
lat_LL
lon_LL
lat_UL
lon_UL
lat_UR
lon_UR
lat_LR
lon_LR

Sci. Var #	**Data Type**	**Label(dimension lengths)**
1	float	Left50%ResponseWavelength(12)
2	float	Central100%ResponseWavelength(12)
3	float	Right50%ResponseWavelength(12)
4	float	SolarSpectralIrradiance(12)
5	short	AnchorPointIndex(73)
6	char	DataSetHeader(6720)
7	short	DataFrameStatus(560)

8	short	RunNumber(560)
9	long	ScanLineCounter(560)
10	long	ThumbWheelSwitches(560)
11	short	ScanRate(560)
12	long	GreenwichMeanTime(560)
13	long	MasTime(560)
14	long	InsTime(560)
15	short	S-BendIndicator(560)
16	short	AircraftRollCount(560)
17	long	YearMonthDay(560)
18	float	ScanlineTime(560)
19	short	BlackBody1Temperature(560 X 12)
20	short	BlackBody2Temperature(560 X 12)
21	short	AmplifierGain(560 X 12)
22	short	BlackBody1Counts(560 X 12)
23	short	BlackBody2Counts(560 X 12)
24	float	CalibrationSlope(560 X 12)
25	float	CalibrationIntercept(560 X 12)
26	float	PixelLatitude(560 X 73)
27	float	PixelLongitude(560 X 73)
28	float	SensorZenithAngle(560 X 73)
29	float	SensorAzimuthAngle(560 X 73)
30	float	SolarZenithAngle(560 X 73)
31	float	SolarAzimuthAngle(560 X 73)
32	float	AircraftLatitude(560)
33	float	AircraftLongitude(560)
34	float	AircraftHeading(560)
35	float	AircraftAltitude(560)
36	float	AircraftPitch(560)
37	short	CalibratedData(560 X 12 X 716)

NOTES ON DATA

Dimension lengths show above may vary between files due to variations in the amount of data collected per flight track.

These files also include some Level-0 MAS engineering data. The Level-0 data variables are identified in NASA Technical Memorandum 104594, Vol. 3, which is titled:

MODIS Technical Report Series, Volume 3, MODIS Airborne Simulator Level 1B Data User's Guide.

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INSTRUMENTATION:

The MODIS Airborne Simulator (MAS) is a modified Daedalus Wildfire scanning spectrometer. The MAS spectrometer acquires high spatial resolution imagery in the wavelength range 0.55 to 14.3 microns. A total of 50 spectral bands are available in this range, and the digitizer can be configured to record any 12 of them during a flight.

6.0 Implementation Notes

6.1 FIRE Cirrus 2 ASTEX and FIRE Cirrus 2 MAS Program

This interactive read program first requests the name of an input data file. The program opens the file and extracts a list of the data parameters it contains. This list is presented to the user a screen full at a time. The user indicates which parameters should be included in the output report file. All parameters may be selected by entering a zero as the first selection. Upon completion of the parameter selection process, the user is given the option of including all the global variables within the data file. A report file is then generated. A sample execution of the program is shown below:

sorcerer% mas_netcdf_read_c
This program reads the FIRE_ASTEX and FIRE_MAS netCDF data.
Please enter Q to Quit or C to continue c

Please enter netCDF file name to read:
ci2_mas_911031.001
Report file name is: ci2_mas_911031.001.rpt

```
 Item      Data Type        Label(dimension lengths)
 ====     =========     ========================

   1      float      Left50%ResponseWavelength(12)
   2      float      Central100%ResponseWavelength(12)
   3      float      Right50%ResponseWavelength(12)
   4      float      SolarSpectralIrradiance(12)
   5      short       AnchorPointIndex(73)
   6       char       DataSetHeader(6720)
   7      short       DataFrameStatus(560)
   8      short       RunNumber(560)
```

```
  9      long     ScanLineCounter(560)
 10      long     ThumbWheelSwitches(560)
 11      short    ScanRate(560)
 12      long     GreenwichMeanTime(560)
 13      long     MasTime(560)
 14      long     InsTime(560)
 15      short    S-BendIndicator(560)
```

Please choose the numbers of the data items you wish to dump
Enter -1 to display additional items or zero to end selection process
NOTE: if you enter 0 as very first entry, all variables will be displayed

-1

```
 Item   Data Type   Label(dimension lengths)
 ====   =========   ========================

 16      short    AircraftRollCount(560)
 17      long     YearMonthDay(560)
 18      float    ScanlineTime(560)
 19      short    BlackBody1Temperature(560 X 12)
 20      short    BlackBody2Temperature(560 X 12)
 21      short    AmplifierGain(560 X 12)
 22      short    BlackBody1Counts(560 X 12)
 23      short    BlackBody2Counts(560 X 12)
 24      float    CalibrationSlope(560 X 12)
 25      float    CalibrationIntercept(560 X 12)
 26      float    PixelLatitude(560 X 73)
 27      float    PixelLongitude(560 X 73)
 28      float    SensorZenithAngle(560 X 73)
 29      float    SensorAzimuthAngle(560 X 73)
 30      float    SolarZenithAngle(560 X 73)
```

Please choose the numbers of the data items you wish to dump
Enter -1 to display additional items or zero to end selection process

-1

```
 Item   Data Type   Label(dimension lengths)
 ====   =========   ========================

 31      float    SolarAzimuthAngle(560 X 73)
 32      float    AircraftLatitude(560)
 33      float    AircraftLongitude(560)
 34      float    AircraftHeading(560)
 35      float    AircraftAltitude(560)
 36      float    AircraftPitch(560)
```

```
  37        short       CalibratedData(560 X 12 X 716)

Please choose the numbers of the data items you wish to dump
Enter -1 or zero to terminate selection process
1
2
3
4
0
Would you like the global attributes included in the report? (Y/N)n
```

The data is then written to the report file. Sample output from above is written below:

```
 This is the report file for the ci2_mas_911031.001 file


 Left50%ResponseWavelength
        units = microns
0 , 0.676 , 1.581 , 1.909 , 2.064 , 2.115 , 3.676 , 4.623 , 4.467 , 8.664 ,
    10.7 , 11.7  ;

 Central100%ResponseWavelength
        units = microns
0 , 0.681 , 1.617 , 1.933 , 2.088 , 2.139 , 3.748 , 4.695 , 4.539 , 8.8 ,
    10.95 , 11.95  ;

 Right50%ResponseWavelength
        units = microns
0 , 0.685 , 1.637 , 1.957 , 2.111 , 2.162 , 3.82 , 4.767 , 4.611 , 9.003 ,
    11.2 , 12.2  ;
 SolarSpectralIrradiance
        units = watts/meter2/micron
        title = Sensor Weighted and Orbit Corrected Solar Spectral
        Irradiance
0 , 1517.228 , 249.3575 , 133.1342 , 99.10963 , 85.99516 , 11.9167 ,
    4.973752 , 5.785793 , 0.4060206 , 0.1725588 , 0.1218062  ;
```

APPENDIX

A-1: Output from running 'make all' on HP workstation

```
         cc -g -DHPUX  -I.   -c fci2_lib.c
        rm -f ./lib_fci2.a
        ar rlv ./lib_fci2.a `lorder fci2_lib.o | tsort`
a - fci2_lib.o
ar: creating ./lib_fci2.a
        ranlib ./lib_fci2.a
ranlib: ar already did it for you, see ar(1).
        rm -f class_sonde
        cc  -DHPUX  -I.    -DCLASS_SONDE -o class_sonde fci2_sw.c ./lib_fci2.a
        rm -f csu_prt6
        cc  -DHPUX  -I.    -DCSU_PRT6 -o csu_prt6 fci2_sw.c ./lib_fci2.a
        rm -f csu_sondes
        cc  -DHPUX  -I.    -DCSU_SONDES -o csu_sondes fci2_sw.c ./lib_fci2.a
        rm -f csu_station1
        cc  -DHPUX  -I.    -DSTATION1 -o csu_station1 fci2_sw.c ./lib_fci2.a
        rm -f csu_station2
        cc  -DHPUX  -I.    -DSTATION2 -o csu_station2 fci2_sw.c ./lib_fci2.a
        rm -f csu_wndprfl
        cc  -DHPUX  -I.    -DCSU_WND -o csu_wndprfl fci2_sw.c ./lib_fci2.a
        rm -f doplr_lidar
        cc  -DHPUX  -I.    -DDOPLR_LIDAR -o doplr_lidar fci2_sw.c ./lib_fci2.a
        rm -f maps
        cc  -DHPUX  -I.    -DMAPS -o maps fci2_sw.c ./lib_fci2.a
        rm -f noaa_wndprfl
        cc  -DHPUX  -I.    -DNOAA_WND -o noaa_wndprfl fci2_sw.c ./lib_fci2.a
        rm -f nws_sonde
        cc  -DHPUX  -I.    -DNWS_SONDE -o nws_sonde fci2_sw.c ./lib_fci2.a
        rm -f pams
        cc  -DHPUX  -I.    -DPAMS -o pams fci2_sw.c ./lib_fci2.a
        rm -f raman_lidar
        cc  -DHPUX  -I.    -DRAMAN_LIDAR -o raman_lidar fci2_sw.c ./lib_fci2.a
        rm -f ci2_kingair
        cc  -DHPUX  -I.    -DF2_KINGAIR -o ci2_kingair genpro.c ./lib_fci2.a
        rm -f ci2_sabreliner
        cc  -DHPUX  -I.    -o ci2_sabreliner genpro.c ./lib_fci2.a
        rm -f fhdf_netcdf

       rm -f mas_read_netcdf_c
        cc  -g -Aa -DHPUX      -DNO_HAVE_PROTOTYPES -DNO_STDARG -I../HDF3.3r4/
mfhdf/libsrc -o fhdf_netcdf fhdf_netcdf.c -L../HDF3.3r4/hdf/lib -lnetcdf ../
HDF3.3r4/hdf/lib/libdf.a
```

A-2: Output from running 'make all' on SUN4 workstation:

% make -f Makefile.fci2 all

```
acc -g    -DSUNOS -sun4 -c  fci2_lib.c

rm -f lib_fci2.a

ar rlv lib_fci2.a `lorder fci2_lib.o | tsort`

a - fci2_lib.o

ar: creating lib_fci2.a

ranlib lib_fci2.a

acc -g    -DSUNOS -sun4 -c  fci2_sw.c

"fci2_sw.c", line 1324: warning: argument is incompatible with prototype: arg
#4

"fci2_sw.c", line 1382: warning: argument is incompatible with prototype: arg
#4

"fci2_sw.c", line 1383: warning: argument is incompatible with prototype: arg
#4

rm -f class_sonde

acc -g    -DSUNOS  -sun4 -DCLASS_SONDE -o class_sonde fci2_sw.o ./lib_fci2.a

rm -f csu_prt6

acc -g    -DSUNOS  -sun4 -DCSU_PRT6 -o csu_prt6 fci2_sw.o ./lib_fci2.a

rm -f csu_sondes

acc -g    -DSUNOS  -sun4 -DCSU_SONDES -o csu_sondes fci2_sw.o ./lib_fci2.a

rm -f csu_station1

acc -g    -DSUNOS  -sun4 -DSTATION1 -o csu_station1 fci2_sw.o ./lib_fci2.a

rm -f csu_station2

acc -g    -DSUNOS  -sun4 -DSTATION2 -o csu_station2 fci2_sw.o ./lib_fci2.a

rm -f csu_wndprfl

acc -g    -DSUNOS  -sun4 -DCSU_WND -o csu_wndprfl fci2_sw.o ./lib_fci2.a

rm -f doplr_lidar

acc -g    -DSUNOS  -sun4 -DDOPLR_LIDAR -o doplr_lidar fci2_sw.o ./lib_fci2.a

rm -f maps

acc -g    -DSUNOS  -sun4 -DMAPS -o maps fci2_sw.o ./lib_fci2.a
```

```
rm -f noaa_wndprfl

acc -g    -DSUNOS  -sun4 -DNOAA_WND -o noaa_wndprfl fci2_sw.o ./lib_fci2.a

rm -f nws_sonde

acc -g    -DSUNOS  -sun4 -DNWS_SONDE -o nws_sonde fci2_sw.o ./lib_fci2.a

rm -f pams

acc -g    -DSUNOS  -sun4 -DPAMS -o pams fci2_sw.o ./lib_fci2.a

rm -f raman_lidar

acc -g    -DSUNOS  -sun4 -DRAMAN_LIDAR -o raman_lidar fci2_sw.o ./lib_fci2.a

rm -f ci2_kingair

acc -g    -DSUNOS  -sun4 -DF2_KINGAIR -o ci2_kingair genpro.c ./lib_fci2.a

rm -f ci2_sabreliner

acc -g    -DSUNOS  -sun4 -o ci2_sabreliner genpro.c ./lib_fci2.a

rm -f mas_read_netcdf_c

acc -g    -DSUNOS  -sun4 -DNO_HAVE_PROTOTYPES -DNO_STDARG -I/usr/local/hdf-
3.3r4/mfhdf/libsrc -I/usr/local/hdf-3.3r4/mfhdf/port -I/usr/local/hdf-3.3r4/
hdf/include -o mas_read_netcdf_c mas_read_netcdf.c -L/usr/local/hdf-3.3r4/
mfhdf/libsrc -lnetcdf /usr/local/hdf-3.3r4/hdf/lib/libdf.a

rm -f mas_read_netcdf_f

f77   -sun4 -DNO_HAVE_PROTOTYPES -DNO_STDARG -I/usr/local/hdf-3.3r4/mfhdf/lib-
src -I/usr/local/hdf-3.3r4/mfhdf/port -I/usr/local/hdf-3.3r4/hdf/include -o
mas_read_netcdf_f mas_read_netcdf.f -L/usr/local/hdf-3.3r4/mfhdf/libsrc -
lnetcdf /usr/local/hdf-3.3r4/hdf/lib/libdf.a

mas_read_netcdf.f:

 MAIN:

"mas_constant.i", line 155: Warning: local variable "dfntf_pcdfntf_convex"
never used
```