Cloud Camera Data (FIFE)

Summary:

The FIFE Cloud Camera Data Data Set was collected to document distribution of clouds during FIFE, evaluate algorithms for identifying presence of thin cirrus, and popcorn cumulus clouds, and evaluate the impact of these clouds on retrieval of surface fluxes from satellite data. Clouds could be remotely sensed from both the surface and from satellites. Unlike surface properties, cloud parameters are incompletely retrieved from above or below; there is no ground truth for cloud retrieval algorithms. A camera fitted with a whole-sky ("fish-eye") lens and positioned so that it points directly upwards can capture a full horizon-to-horizon image of the sky dome. Careful film and filter combinations permit differentiation of cloud types. The mathematical mapping of a spherical surface onto a flat surface uses nomenclature from the cartographic community, where the development of techniques for mapping the surface of the earth has a long history. Cartographic projections are precise, mathematically defined 'mappings' and, as a consequence, this nomenclature has been adopted in describing whole-sky camera photographs (Herbert 1986; McGuffie and Henderson-Sellers 1989).

Analysis of the camera data showed considerable temporal variability indicating that synoptic observation of cloud was not adequate. There is indication that the NOAA station report convention (clear, scattered, broken, and overcast) from the nearest synoptic NOAA surface stations (Manhattan Airport, and Fort Riley airfield) were used instead of true okta cloud observations, in the NOAA data.

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20. Document Information

1. Data Set Overview:

Data Set Identification:

Cloud Camera Data (FIFE).
(Cloud Data from the University of Liverpool Sky-Camera).

Data Set Introduction:

The FIFE Cloud Camera Data Data Set contains cloud type, total cloud coverage, and sector cloud coverage information.

Objective/Purpose:

The all sky camera photography were collected for these purposes:

1. to document distribution of clouds during FIFE,
2. evaluate algorithms for identifying presence of thin cirrus, and popcorn cumulus clouds, and
3. evaluate the impact of these clouds on retrieval of surface fluxes from satellite data.

Summary of Parameters:

Cloud type, total cloud coverage, and sector cloud coverage.

Discussion:

Analysis of the camera data showed considerable temporal variability indicating that synoptic observation of cloud was not adequate. There is indication that the NOAA station report convention (clear, scattered, broken, and overcast) from the nearest synoptic NOAA surface stations (Manhattan Airport, and Fort Riley airfield) were used instead of true okta cloud observations, in the NOAA data.

The results of a comparison of cloud amounts obtained from the sky-camera located in the Konza with cloud amounts from the NOAA surface synoptic report at Manhattan and Fort Riley airfields is shown in a graph contained on FIFE CD-ROM Volume 1. This figure is in TIFF format and was taken from the FIFE Interim Report - 1990 (Fig. 4.3.3.6B, page 4-46).

Related Data Sets:

- NOAA Regional Surface Data.
- NOAA Radiosonde Observations.
- NOAA Radiosonde Observations-1989 (NCDC).

- Upper Air Derivative Data from NMC.
- Automated Micrometeorological Observations.
- Solar Transmissometer Aerosol Optical Thickness.
- Sunphotometer Optical Thickness Data from C130 Aircraft.

FIS Data Base Table Name:

CLOUD_CAMERA_DATA.

2. Investigator(s):

Investigator(s) Name and Title:

Dr. Ann Henderson-Sellers
Macquarie University

Title of Investigation:

Staff Science Ancillary Data Acquisition Program.

Contact Information:

Contact 1:
Dr. A. Henderson-Sellers
Macquarie University
Australia
Email: ann@@mqclimat.mqcc.mq.oz.au

Requested Form of Acknowledgment.

The Cloud Data from the University of Liverpool Sky-Camera was collected by A. Henderson-Sellers. The contribution of these data is particularly appreciated.

3. Theory of Measurements:

Clouds could be remotely sensed from both the surface and from satellites. Unlike surface properties, cloud parameters are incompletely retrieved from above or below; there is no ground truth for cloud retrieval algorithms. A camera fitted with a whole-sky ("fish-eye") lens and positioned so that it points directly upwards can capture a full horizon-to-horizon image of the sky dome. Careful film and filter combinations permit differentiation of cloud types. The mathematical mapping of a spherical surface onto a flat surface uses nomenclature from the cartographic community, where the development of techniques for mapping the surface of the earth has a long history. Cartographic projections are precise, mathematically defined 'mappings' and, as a consequence, this nomenclature has been adopted in describing whole-sky camera photographs (Herbert 1986; McGuffie and Henderson-Sellers 1989).

It is impossible for a hemisphere to be projected onto a flat surface without some distortion. For many purposes it is important that this distortion be minimized, so that it affects aspects of the image that are of lesser importance. Amongst the various projections, the equal area projection is most suitable for cloud photography because of the way it mimics the surface observer's procedure for estimating cloud amounts. Also, the process of compression of the images enhances contrast on features within, e.g., apparently featureless stratiform cloud decks. A number of different optical approaches are suitable for projecting an image of the whole sky onto a plane surface. The latter includes refracting lens, reflecting lens, and moving film systems (Herbert 1987).

Surface observer estimates of cloud cover can be affected by psychological biases of the person observing. Whole-sky cameras potentially offer a way of quantifying these effects, and have also been used to supplement radiometric measurements of the distribution of diffuse solar radiation over the sky dome.

4. Equipment:

Sensor/Instrument Description:

"All-Sky" Single Lens Reflex (SLR) camera fitted with a full fish-eye 180 degree FOV lens, 7.5 mm focal length.

Collection Environment:

Ground-based.

Source/Platform:

Two cameras were operated. One was located in the northwest quadrant of the FIFE experiment area, slightly southeast of the center of the Konza Prairie Research Natural Area, near the Argonne tower (Station 998). The other was on the roof of Kansas State University Physics Building (Station 50), approximately 10 km north of the FIFE experiment area.

Source/Platform Mission Objectives:

The general objective of the all-sky camera was to measure the amount of clouds and characterize the state of the atmosphere over the FIFE site during the experiment periods.

Key Variables:

The cloud type, total cloud coverage, sector cloud coverage, and type of photograph.

Principles of Operation:

A standard Single Lens Reflex (SLR) camera was used to record pictures of the sky. The optical approach used for projecting an image of the whole sky onto a plane surface is via a refraction

system. A fish-eye lens is attached to a 35-mm SLR camera to record the image of the sky. The sophisticated lens design produces a projection which corrects for most distortions, and sharpness. The resulting circular image is an image of the whole sky dome (when the camera points at the zenith).

The projections employed by whole-sky cameras preserve azimuthal projections. Radial distances are distorted in a manner that depends on the projection in use, which in turn depends to a large extent on the intended purpose of the images. The equal area projection is most suitable for cloud photography because of the way it mimics the surface observer's procedure for estimating cloud amounts.

Sensor/Instrument Measurement Geometry:

The cameras were fitted with full fish-eye 180 degree FOV lenses 7.5 mm focal length. The camera was aimed at the zenith to provide a hemispherical view of the sky.

Manufacturer of Sensor/Instrument:

University of Liverpool
P.O. Box 147
Liverpool, United Kingdom.

Calibration:

The investigator did not provide information on calibration, but Herbert (1986) discussed calibration of fish-eye lenses using area projections.

Specifications:

The camera on the Physics building always used black and white negative film.

On the Konza, predominantly color positive film was used, but odd days shots have black and white pictures.

The cameras were fitted with full fish-eye 180 degree FOV lenses 7.5 mm focal length.

Tolerance:

Not available at this revision.

Frequency of Calibration:

Not known.

Other Calibration Information:

None.

5. Data Acquisition Methods:

Two "all-sky" cameras (180 degrees fish-eye lenses) were used to photograph daylight cloud scenes. There were 2026 Color photos and 3635 black and white for a grand total of 5661 pictures. The imagery is held as black and white negative and color positive film, at the University of Liverpool. A 34-element circular grid was used to retrieve total cloud amount and observable high cloud amount in oktas (eighths), according to the British Meteorological Office procedures.

Note: The investigator did not explicitly specify the projection that was used for the grid.

The sky cover is estimated in eighths, with special meanings for 1 and 7, because they encompass situations of trace amounts of clouds (<< 1 okta) and situations with small breaks (<< 1 okta) respectively.

6. Observations:

Data Notes:

Not available.

Field Notes:

High clouds normally have their bases above 6000 m in temperate latitudes, from surface observations they have a thin wispy appearance.

7. Data Description:

Spatial Characteristics:

The FIFE site, with areal extent of 15 km by 15 km, is located south of the Tuttle Reservoir and Kansas River, and about 10 km from Manhattan, Kansas, USA. The northwest corner of the area has UTM coordinates of 4,334,000 Northing and 705,000 Easting in UTM Zone 14.

Spatial Coverage:

The data were collected at two stations, one was near the Argonne tower on the Konza Prairie, and the other was on the Physics Building next to the Evapotranspiration Laboratory on the campus of Kansas State University. The locations are listed below:

LOCATION	SITEGRID_ID	LATITUDE	LONGITUDE	NORTHING	EASTING	ELEV
Argonne Tower	2731-CAM	39 05 01	-96 33 34	4328678	711110	446

Physics Bldg. XCCP-CAM

Spatial Coverage Map:

Not available.

Spatial Resolution:

Thirty-four all-sky camera segments contained in a circle projected from 180 degree field-of-view of the sky. A diagram depicting these segments is included on FIFE CD-ROM Volume 1. This diagram is taken from the FIFE Interim Report - 1990, Figure 4.3.3 6A page 4-44. (see the *Graphs and Plots Section* for more details).

Projection:

Not available.

Grid Description:

Not available.

Temporal Characteristics:

Temporal Coverage:

Data collection from the Physics Building Camera in IFC-1, started on March 5, 1987 through October 17, 1989, and on January 10, 1989, through August 12, 1989. Collection from the Konza Camera began in IFC-1 for the Konza Camera on May 25, 1987 through October 17, 1987. Both collections lasted till the end of IFC-4 in October, 1987. The additional data collected during the 1989 IFC was analyzed using the same procedures that was applied to the 1987 data.

Temporal Coverage Map:

Not available.

Temporal Resolution:

Both cameras used 40 minute sampling interval with coverage only during daylight hours.

Each block of data contains data for one Kansas day, sunrise to sunset. Note, that this straddles 2 GMT days

Data Characteristics:

The SQL definition for this table is found in the CLD_CAM.TDF file located on FIFE CD-ROM Volume 1.

Parameter/Variable Name

Parameter/Variable Description	Range	Units	Source
SITEGRID_ID This is a FIS grid location code. Site grid codes (SSEE-III) give the south (SS) and east (EE) cell number in a 100 x 100 array of 200 m square cells. The last 3 characters (III) are an instrument identifier.			FIS
STATION_ID The three-digit FIFE site, identification number for the site where the data were collected.	50, 998		
OBS_DATE The date on which the data were collected.	min = 05-MAR-87, max = 12-AUG-89		
OBS_TIME The time of day that the data were collected, given as the midpoint of 30 minute average.	min = 0, max = 2540	[GMT]	
CLOUD_TYPE_CODE When present, this column indicates the type of clouds. If the field is blank, then the date and time identify a photograph.	T = total clouds, H = high clouds		
TOTAL_CLOUD_COVRG The amount of clouds that an observer should have reported, according to the British Meteorological Office procedures.	min = 0, max = 8	[Oktas] (Eighths)	
SECTOR_CLOUD_COVRG The amount of cloud in each of the 34 grid sectors defined for	min = 00000000000000000000000000000000000, max = 97444557777788777588888888888888888		

the field of view of the camera. Grid sector numbers increase from left to right. 9 is missing data.		[oktas] (Eighths)
AVG_SECTOR_CLOUD_COVRG The arithmetic mean of the 34 grid sectors for this observation.	min = 0, max = 8	
PHOTO_TYPE Denotes whether the photograph was color or black and white. and white	COL = colour, BW = black	
FIFE_DATA_CRTFCN_CODE The FIFE Certification Code for the data, in the following format: CPI (Certified by PI), CPI-??? (CPI - questionable data).	* CPI = checked by primary investigator	
LAST_REVISION_DATE in the format (DD-MMM-YY).	max = 01-SEP-92	

Footnote:

* Valid levels

The primary certification codes are:

EXM Example or Test data (not for release). PRE Preliminary (unchecked, use at your own risk). CPI Checked by Principal Investigator (reviewed for quality). CGR Checked by a group and reconciled (data comparisons and cross-checks).

The certification code modifiers are:

PRE-NFP Preliminary - Not for publication, at the request of investigator. CPI-MRG PAMS data that are "merged" from two separate receiving stations to eliminate transmission errors. >dt>CPI-??? Investigator thinks data item may be questionable.

Sample Data Record:

SITEGRID_ID	STATION_ID	OBS_DATE	OBS_TIME	FILE_NAME	CLOUD_TYPE_CODE
XCCP-CAM	998	06-JUN-87	1900	CLOUDDTG.LIV	T
XCCP-CAM	998	06-JUN-87	1900	CLOUDDTG.LIV	H
XCCP-CAM	998	06-JUN-87	1940	CLOUDDTG.LIV	T
XCCP-CAM	998	06-JUN-87	1940	CLOUDDTG.LIV	H

TOTAL_CLOUD_COVRG	SECTOR_CLOUD_COVRG

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-----------------                       ---------------------------------
00000000000000000000000000000000000
00000000000000000000000000000000000
00000000000000000000000000000000000
00000000000000000000000000000000000
AVG_SECTOR_CLOUD_COVRG   PHOTO_TYPE   FIFE_DATA_CRTFCN_CODE
----------------------   ----------   ---------------------
.00                  BW              CPI
.00                  BW              CPI
.00                  BW              CPI
.00                  BW              CPI
LAST_REVISION_DATE
------------------
30-JUN-88
30-JUN-88
30-JUN-88
30-JUN-88
```

8. Data Organization:

Data Granularity:

Each block of data contains data for one Kansas day, sunrise to sunset.

A general description of data granularity as it applies to the IMS appears in the EOSDIS Glossary.

Data Format:

The CD-ROM file format consists of numerical and character fields of varying length separated by commas. The character fields are enclosed with a single apostrophe. There are no spaces between the fields. Each file begins with five header records. Header records contain the following information:

Record 1 Name of this file, its table name, number of records in this file, path and name of the document that describes the data in this file, and name of principal investigator for these data. Record 2 Path and filename of the previous data set, and path and filename of the next data set. (Path and filenames for files that contain another set of data taken at the same site on the same day.) Record 3 Path and filename of the previous site, and path and filename of the next site. (Path and filenames for files of the same data set taken on the same day for the previous and next sites (sequentially numbered by SITEGRID_ID)). Record 4 Path and filename of the previous date, and path and filename of the next date. (Path and filenames for files of the same data set taken at the same site for the previous and next date.) Record 5 Column names for the data within the file, delimited by commas. Record 6 Data records begin.

Each field represents one of the attributes listed in the chart in the *Data Characteristics Section* and described in detail in the TDF file. These fields are in the same order as in the chart.

9. Data Manipulations:

Formulae:

Derivation Techniques and Algorithms:

Cloud amounts are derived from the area covered by cloud on a transparent grid of all sky-camera segments overlaid on the sky photographs. Haze, especially around the horizon, was excluded.

The cloud is reported either as total (T) amount of the sky dome covered by low, middle and high cloud or else the amount of high cloud (H) obscuring the sky dome.

Data Processing Sequence:

Processing Steps:

After exposure films are processed and a grid of the all-sky camera segments is superimposed on the photograph to estimate the amount of clouds.

Grid data are retrieved from the grid from the center outwards.

Processing Changes:

None.

Calculations:

Special Corrections/Adjustments:

None.

Calculated Variables:

None.

Graphs and Plots:

The relationship between the all sky-camera cloud amounts and the NOAA surface synoptic reports are shown in a figure on FIFE CD-ROM Volume 1. This figure was taken from the FIFE Interim Report - 1990 Fig. 4.3.3.6B, page 4-46. In addition, a figure showing the segmentation of the sky used for the sky-camera data is also on FIFE CD-ROM Volume 1. This figure was taken from the FIFE Interim Report - 1990 Fig. 4.3.3.6A, page 4-44.

10. Errors:

Sources of Error:

Errors could arise due to mistakes by human interpreters in estimating cloud amounts from the grid overlays. Also, incorrect setting of the camera clock could lead to errors in the data.

Quality Assessment:

Data Validation by Source:

Ten percent of all the analyzed data were cross-checked by an independent analyst.

Confidence Level/Accuracy Judgment:

There is no discernible bias. The investigators are confident about the total cloud amounts. High cloud amount estimates are less reliable since there is greater uncertainty in identification of the exact type of cloud than in its amount.

Measurement Error for Parameters:

The RMS error on the total cloud amount is 0.7 oktas.

Additional Quality Assessments:

The data were compared with the NOAA surface observations from nearby NOAA stations (Manhattan and Fort Riley airfields).

FIS staff applied a general Quality Assessment (QA) procedure to the data to identify inconsistencies and problems for potential users. As a general procedure, the FIS QA consisted of examining the maximum, minimum, average, and standard deviation for each numerical field in the data table. An attempt was made to find an explanation for unexpected high or low values, values outside of the normal physical range for a variable, or standard deviations that appeared inconsistent with the mean. In some cases, histograms were examined to determine whether outliers were consistent with the shape of the data distribution.

The discrepancies, which were identified, are reported as problems in the *Known Problems with the Data Section*.

Data Verification by Data Center:

The data verification performed by the ORNL DAAC deals with the quality of the data format, media, and readability. The ORNL DAAC does not make an assessment of the quality of the data itself except during the course of performing other QA procedures as described below.

The FIFE data were transferred to the ORNL DAAC via CD-ROM. These CD-ROMs are distributed by the ORNL DAAC unmodified as a set or in individual volumes, as requested. In addition, the DAAC has incorporated each of the 98 FIFE tabular datasets from the CD-ROMs into its online data holdings. Incorporation of these data involved the following steps:

- Copying the entire FIFE Volume 1, maintaining the directory structure on the CD-ROM;
- Using data files, documentation, and SQL code provided on the CD-ROM to create a database in Statistical Analysis System (SAS); and
- Creating transfer files to transfer the SAS metadata database to Sybase tables.

Each distinct type of data (i.e. "data set" on the CD-ROM), is accompanied by a documentation file (i.e., .doc file) and a data format/structure definition file (i.e., .tdf file). The data format files on the CD-ROM are Oracle SQL commands (e.g., "create table") that can be used to set up a relational database table structure. This file provides column/variable names, character/numeric type, length, and format, and labels/comments. These SQL commands were converted to SAS code and were used to create SAS data sets and subsequently to input data files directly from the CD-ROM into a SAS dataset. During this process, file names and directory paths were captured and metadata was extracted to the extent possible electronically. No files were found to be corrupted or unreadable during the conversion process.

Additional Quality Assurance procedures were performed as follows:

- Statistical operations were performed to calculate minimum and maximum values for all numeric fields and to create a listing of all values of the character fields. During this process, it was determined that various conventions were used to represent missing values. (Note: no modifications were made to any data by the DAAC). In most cases, missing value identification conventions were discussed in the accompanying .doc file. Based on a visual check of the minimum and maximum values, no glaring errors or holes were identified that might indicate errors introduced during CD-ROM mastering by the FIFE project or data ingest by the DAAC.
- Some minor inconsistencies and typographical errors were identified in some of the character fields and column labels, however, no modifications were made to the data by the DAAC.
- Some conversions of ASCII data were necessary to move the data from a DOS platform to a UNIX platform. Standard operating system conversion utilities were used (e.g., dos2unix).
- Much of the metadata required for archival is imbedded in the narrative documentation accompanying the data sets and extracted manually by DAAC staff who have read the .doc files provided on the CD-ROM and have hand entered this information into the metadata database maintained by the DAAC. QA procedures have been performed on these metadata to identify and eliminate typographical errors and inconsistencies in naming conventions, to ensure that all required metadata is present, and to ensure the accuracy of file names and paths for retrieval.
- Data requested for distribution to users are checked to verify that files copied from disk to other media remain uncorrupted.

As errors are discovered in the online tabular data by investigators, users, or DAAC staff, corrections are made in cooperation with the principal investigators. These corrections are then distributed to users. CD-ROM data are corrected when re-mastering occurs for replenishment of CD-ROM stock.

11. Notes:

Limitations of the Data:

Not available.

Known Problems with the Data:

There was a problem reconstructing the 1989 date/time sequence. Due to uncertainties in the documentation provided by the investigator with the original cloud camera pictures, the times associated with August 11, 1989 data are approximate. These times are given as "whole hour" values, which could be in error by as much as +/- 59 minutes (i.e., a 16:00 time corresponds to a cloud camera photograph taken between 15:00 and 16:59). Times associated with other days are assumed to be correct.

The results of the comparison with NOAA surface observations are included in a graph found on FIFE CD-ROM Volume 1 which was copied from the FIFE Interim Report - 1990.

Usage Guidance:

Errors could arise when conventional weather station method is used and then reported as true okta observations. See the *Other Relevant Information Section* for a more detailed discussion of this.

Any Other Relevant Information about the Study:

There is some concern from the investigator regarding the cloud amount observations made at Manhattan Airport and Fort Riley, the two nearest synoptic NOAA stations. The investigator noted that the observations from these two stations were very odd-to say the least. No cloud amount other than clear, 3, 6, and 8 oktas were ever reported!! Having looked through the whole 1987 data (the graphs referenced in the *Graphs and Plots Section* compare data for the sky-camera mounted near the Konza with data from the two NOAA stations). It was noted that no numbers other than those mentioned above were reported. It is very odd, bearing in mind that second and third cloud layers are only reported if the amounts are above specified thresholds (usually 3 and 5 oktas, respectively).

The investigator insists that "there is NO WAY" anyone could use the data from the two NOAA stations. For example, the reported 3 oktas could mean anything from a single tiny cumulus in an otherwise clear sky through a half-cloudy sky! It could be more understandable if it were 2, 6, and 8 oktas that are favored since conversion from the tenths scale (which may be the units used for these observations) groups 2 and 3 tenths into 2 oktas, and 7 and 8 into 6 oktas, but even so there is NO reason for the absence of 1, 2, 4, 5, or 7 oktas observations.

Although most investigators in FIFE were not overly concerned with clouds, the identification of cloud-free days and times during the experiment could be erroneous if these NOAA surface data from Manhattan and Fort Riley are used.

12. Application of the Data Set:

This data set can be used to evaluate algorithms for identifying presence of thin cirrus, and popcorn cumulus clouds, and evaluate the impact of these clouds on retrieval of surface fluxes from satellite data.

13. Future Modifications and Plans:

The FIFE field campaigns were held in 1987 and 1989 and there are no plans for new data collection. Field work continues near the FIFE site at the Long-Term Ecological Research (LTER) Network Konza research site (i.e., LTER continues to monitor the site). The FIFE investigators are continuing to analyze and model the data from the field campaigns to produce new data products.

14. Software:

Software to access the data set is available on the all volumes of the FIFE CD-ROM set. For a detailed description of the available software see the *Software Description Document*.

15. Data Access:

Contact Information:

ORNL DAAC User Services
Oak Ridge National Laboratory

Telephone: (865) 241-3952
FAX: (865) 574-4665

Email: ornldaac@@ornl.gov

Data Center Identification:

ORNL Distributed Active Archive Center
Oak Ridge National Laboratory
USA

Telephone: (865) 241-3952
FAX: (865) 574-4665

Email: ornldaac@@ornl.gov

Procedures for Obtaining Data:

Users may place requests by telephone, electronic mail, or FAX. Data is also available via the World Wide Web at http://daac.ornl.gov.

Data Center Status/Plans:

FIFE data are available from the ORNL DAAC. Please contact the ORNL DAAC User Services Office for the most current information about these data.

16. Output Products and Availability:

Cloud Data from the University of Liverpool Sky-Camera are available on FIFE CD-ROM Volume 1. The CD-ROM filename is as follows:

\DATA\SUR_MET\CLD_CAM\GRIDxxxx\YyyMmm\ydddgrid.CCM

Where *xxxx* is the four digit code for the location within the FIFE sitegrid, *yy* is the last two digits of the year (e.g. Y87 = 1987) and *mm* is the month of the year (e.g. M12 = December). Note: capital letters indicate fixed values that appear on the CD-ROM exactly as shown here, lower case indicates characters (values) that change for each path and file.

The format used for the filenames is: *ydddgrid.sfx,* where *grid* is the four number code for the location within the FIFE site grid, *y* is the last digit of the year (e.g. 7 = 1987, and 9 = 1989), and *ddd* is the day of the year (e.g. 061 = sixty-first day in the year). The filename extension (*.sfx*), identifies the data set content for the file (see the *Data Characteristics Section*) and is equal to .CCM for this data set.

17. References:

Satellite/Instrument/Data Processing Documentation.

Henderson-Sellers, A., G. Seze, F. Drake, and M. Desbois. 1987. Surface-observed and satellite-retrieved cloudiness compared for the 1983 ISCCP special study area for Europe. J. Geophys. Res. 92:4019-4034.

Journal Articles and Study Reports.

Herbert, T.J. 1986. Calibration of fish-eye lenses by inversion of area projections. Appl. Opt. 25:1875-1876.

Herbert, T.J. 1987. Area projections of fish-eye photographic lenses. Agric. Forest Meteorol. 39:215-223.

Hill, R. 1924. A lens for whole sky photographs. Quart. J. Royal. Meteor. Soc. 50:227-235.

McGuffie, K., and A. Henderson-Sellers. 1989. Almost a century of "imaging" clouds over the whole-sky dome. Bull. Amer. Meteor. Soc. 70:1243-1253.

Sellers, P.J., F.G. Hall, D.E. Strebel, R.D. Kelly, S.B. Verma, B.L. Markham, B.L. Blad, D.S. Schimel, J.R. Wang, and E. Kanemasu. 1990. FIFE Interim Report. GSFC/NASA, Greenbelt, MD.

Archive/DBMS Usage Documentation.

Contact the EOS Distributed Active Archive Center (DAAC) at Oak Ridge National Laboratory (ORNL), Oak Ridge, Tennessee (see the *Data Center Identification Section*). Documentation about using the archive and/or online access to the data at the ORNL DAAC is not available at this revision.

18. Glossary of Terms:

A general glossary for the DAAC is located at Glossary.

19. List of Acronyms:

CD-ROM Compact Disk-Read Only Memory DAAC Distributed Active Archive Center EOSDIS Earth Observing System Data and Information System FIFE First ISLSCP Field Experiment FIS FIFE Information System FOV Field-of-View GSFC Goddard Space Flight Center IFOV Instantaneous Field-of-View ISLSCP International Satellite Land Surface Climatology Project ORNL Oak Ridge National Laboratory SLR Single Lens Reflex URL Uniform Resource Locator UTM Universal Transverse Mercator

A general list of acronyms for the DAAC is available at Acronyms.

20. Document Information:

April 24, 1994 (citation revised on October 16, 2002).

Warning: This document has not been checked for technical or editorial accuracy by the FIFE Information Scientist. There may be inconsistencies with other documents, technical or editorial errors that were inadvertently introduced when the document was compiled or references to preliminary data that were not included on the final CD-ROM.

Previous versions of this document have been reviewed by the Principal Investigator, the person who transmitted the data to FIS, a FIS staff member, or a FIFE scientist generally familiar with the data.

Document Review Date:

January 13, 1996.

Document ID:

ORNL-FIFE_CLD_CAM.

Citation:

Cite this data set as follows:

Henderson-Sellers, A. 1994. Cloud Camera Data (FIFE). Data set. Available on-line [http://www.daac.ornl.gov] from Oak Ridge National Laboratory Distributed Active Archive Center, Oak Ridge, Tennessee, U.S.A. doi:10.3334/ORNLDAAC/28. Also published in D. E. Strebel, D. R. Landis, K. F. Huemmrich, and B. W. Meeson (eds.), Collected Data of the First ISLSCP Field Experiment, Vol. 1: Surface Observations and Non-Image Data Sets. CD-ROM. National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Maryland, U.S.A. (available from http://www.daac.ornl. gov).

Document Curator:

DAAC Staff

Document URL:

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