SE-590 Reflectance & Radiances (FIFE)

Summary:

The SE-590 Reflectance Factors and Radiances Measured from a Helicopter Data Set were collected using the helicopter-borne SE-590 during Intensive Field Campaign 5 (IFC-5) in 1989. These data were collected at 17 different grid locations within the FIFE study area. Data were collected on 6 days from July 28, 1989 through August 8, 1989, when sky conditions were clear.

The helicopter missions were designed to provide a means of spectrally characterizing each FIFE site and provide an intermediate scale of sampling between that of the surface measurements and the higher altitude aircraft and spacecraft multispectral imaging devices. The SE-590 instrumentation was chosen to provide compatibility with surface-based radiometers and TM spacecraft sensors. Off-nadir measurements were made as a means of providing more accurate estimates of hemispherical reflectance and for use with bi-directional reflectance models.

Table of Contents:

1. Data Set Overview:

Data Set Identification:

SE-590 Reflectance & Radiances (FIFE).
(SE-590 Reflectance Factors and Radiances Measured from a Helicopter).

Data Set Introduction:

The SE-590 Reflectance Factors and Radiances Measured from a Helicopter Data Set contains wavelength, reflectance, standard deviation of the reflectance data.

Objective/Purpose:

The FIFE Staff Science effort covered those activities which were community level activities, or which required uniform data collection procedures across sites and time. Hence, these activities were more appropriate for a team under the direction of a single scientist who would respond to the needs of the Science Steering Group of the experiment. This included the acquisition of the multispectral radiometer data from FIFE sites using a helicopter platform.

Summary of Parameters:

Wavelength, reflectance, standard deviation of the reflectance.

Discussion:

The data were collected using the helicopter-borne SE-590 during Intensive Field Campaign 5 (IFC-5) in 1989. There are no data for 1987. These data were collected at 17 different grid locations within the FIFE study area. Data were collected on 6 days from July 28, 1989 through August 8, 1989, when sky conditions were clear.

Related Data Sets:

- SE-590 Reflectance Factors and Radiances from UNL. This data set contains nadir and off-nadir SE590 spectrometer reflectances measurements from the University of Nebraska group.
- SE-590 Spectroradiometer Reflectance Factors from GSFC. This data set contains nadir SE-590 spectrometer reflectances measurements from the Elizabeth Middleton at NASA Goddard Space Flight Center.
- Surface Reflectances Measured by the PARABOLA. This data set contains Don Deerings PARABOLA data; sky and ground radiance values collected using a sphere-scanning radiometer. This data has been averaged to give equal intervals of viewing angles.
- Surface Reflectance Measured with a Helicopter-borne MMR. This data set contains site averaged reflected radiance and reflectance values from a Barnes MMR taken from a helicopter.
- Surface Radiant Temperature Measured with a Helicopter-borne Infrared Thermometer. This data set contains data from the Everest IR thermometer mounted on the helicopter.

FIS Data Base Table Name:

SE590_HELO_DATA.

2. Investigator(s):

Investigator(s) Name and Title:

Staff Science.

Title of Investigation:

Staff Science Helicopter Data Acquisition Program.

Contact Information:

Contact 1:
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Requested Form of Acknowledgment.

The SE-590 Reflectance Factors and Radiances Measured from a Helicopter data were collected by a dedicated team of pilots, mechanics, photographers and scientists. The efforts of the following individuals are notable: Helicopter crew: Charles Walthall, mission scientist;

William Dykes, pilot; Charles Smith, mechanic and observer; Ed Bohles, mechanic and observer; Richard Huey, photographer; David Pierce, engineer; Douglas Young, engineer; US Army 82nd Medical Helicopter Unit, Ft. Riley, Kansas for on-site hanger space and helicopter technical support.

3. Theory of Measurements:

The helicopter missions were designed to provide 1) a rapid means of intensively, spectrally characterizing each FIFE site while providing FIFE study area coverage, and 2) to provide an intermediate scale of sampling between that of the surface measurements and the higher altitude aircraft and spacecraft multispectral imaging devices. The SE-590 instrumentation was chosen to provide compatibility with surface-based radiometers and TM spacecraft sensors. Off-nadir measurements were made as a means of providing more accurate estimates of hemispherical reflectance and for use with bi-directional reflectance models.

4. Equipment:

Sensor/Instrument Description:

The Spectron Engineering SE-590 is a portable, battery operated spectro-radiometer consisting of a data analyzer/logger controller, spectral detector head and an external battery charger/power supply. The controller is a self contained microprocessor based unit which processes the signal from the head, amplifying and digitizing it with 12 bit resolution. For each spectral scan, the controller actuates the spectral head shutter, measures and stores the dark current, calculates optimum integration time, acquires the spectrum and automatically subtracts the noise for all 256 spectral elements. A series of scans can be taken and automatically averaged. The spectrum is stored in a double precision register which saves the entire 12-bit binary spectra until it is transmitted through the RS-232C port. The spectral detector head uses a defraction grating as the dispersive element; the spectrum is imaged onto a 256 element photodiode array. Each element integrates simultaneously acquiring the spectrum in a fraction of a second. The interconnect cable from the spectral head to the controller couples the spectral signals to the controller, timing and control signals to the head. A shutter in the head, operated by the controller closes the light path for dark current measurements. For further information consult the SE-590 operating manual or Spectron Engineering, Denver, Colorado.

Collection Environment:

Airborne.

Source/Platform:

During 1989 the SE-590 (serial number 1571) was mounted on a pointable mount attached to the starboard side of a NASA Bell UH-1B "Huey" helicopter (NASA 415). The data collection system and methodology were developed for prior experiments over forested areas (Williams et al., 1984).

Source/Platform Mission Objectives:

There were two type of helicopter optical system missions: H-1a and H-1b. The objective of the H-1a missions was to acquire spectral data of specific FIFE sites coincident with surface, atmospheric and satellite measurements. The objective for the H-1b missions was to acquire multispectral data of as many FIFE sites during the available flight time. All regular FIFE sites were measured from a hover. Some special sites were flown in a slow-flight transect mode.

The area for observations within a site differed for the three primary sites (906, 916 and 928) from the other FIFE sites. The "WAB" area was outlined by crews on the surface with flags: the two edges and a center line directly into the wind were marked. Using these lines as guides, slow flight transects with an average of 8 observations per line were flown. Sampling of the other FIFE sites followed the 1987-type pattern of sampling. The sample area for these sites was a doughnut-like ring around the automated weather stations or over areas where surface radiance and biology measurements were being conducted. The ring around the weather stations was 2-3 times the width of the weather station areas (the instruments were normally bounded by fences).

Key Variables:

Reflected radiation, emitted radiation, and surface temperature.

Principles of Operation:

The SE590 spectral detector head uses a defraction grating as a spectral discrimination element; the spectrum is imaged onto a 256 element photodiode array. Each element integrates simultaneously acquiring the spectrum in a fraction of a second. Gain is set based on maximum levels recorded by a scan taken before the actual data collection scan.

Sensor/Instrument Measurement Geometry:

When mounted on the helicopter, the optical head is equipped with lenses having a 1 degree FOV. Given a nominal data acquisition altitude of 330 m, spectral irradiance from the ground surface area of a circle with an approximate diameter of 5.76 m is recorded. Off-nadir view angles were possible in the backscatter direction using the pointable mount.

Manufacturer of Sensor/Instrument:

Spectron Engineering, Inc.
255 Yuma Court
Denver, Colorado 80223
(303) 733-1060

Calibration:

Calibration of the SE-590 for absolute radiance was carried out by Staff/GSFC using transfer radiometer procedures. The calibration procedures and specifics can be found in Markham 1987; and Markham et al., 1988. Estimates of irradiance were derived from the use of a separate SE-590 located on the surface mounted over a horizontal BaSO4 reflectance panel using a 15 degree field-of-view lens. The calibration panel was operated by University of Nebraska SRB personnel. No corrections were made for the temperature sensitivity (Blad et al., 1990). A post-season wavelength calibration was performed. The post-season radiance and wavelength calibrations were performed at Goddard Space Flight Center.

Specifications:

Each SE-590 has a unique wavelength associated with each of its 252 bands. So that wavelength to wavelength comparisons could be made among SE-590s used at FIFE, a cubic spline interpolation was applied to the 252 bands to standardize the wavelengths to every 5 nm from 400 to 1000 nm.

Tolerance:

Results from the temperature dependency data indicated that measurements at wavelength of 1000 nm may result in discrepancies of approximately 50 W/m**2/sr/um if the instrument temperature varies for 16 to 43.5 degree C (Blad et al., 1990).

Frequency of Calibration:

BaSO4 measurements were made at intervals no longer than 20 minutes apart with the start of daily data collection being 30 minutes prior to the first helicopter mission and ending 30 minutes after the last helicopter mission of the day.

Other Calibration Information:

Not available at this revision.

5. Data Acquisition Methods:

The NASA Bell UH-1B helicopter optical remote sensing system for 1989 supported a data acquisition system consisting of a boresighted SE-590; a color video camera; and one 35 mm flight research camera loaded with color film. Controller units for all the optical devices are rack-mounted inside the helicopter and are wired such that a single switch closure triggers all devices. The switch closure also activates an audible tone which is recorded on one of the two audio tracks of a Beta-format video recording system. The other audio track of the VCR was used to record cabin intercom conversations among the helicopter crew. If one desires to examine site conditions in greater detail, the higher resolution 35 mm still photography can be reviewed. Note that the 35 mm camera was secured in a nadir-looking configuration. The video camera was mounted on the pointable platform with the radiometric instruments.

6. Observations:

Data Notes:

Not available.

Field Notes:

Special targets include Off-nadir data is limited to backscatter measurements, and is limited in quantity. Data quality checks have not been made. No atmospheric corrections have been made.

7. Data Description:

Spatial Characteristics:

The FIFE study area 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:

All view zenith angles were measured with respect to gravity not in relation to the slope of the plot. These measurement plots were located northeast of the Wind Aligned Blob (WAB) site (Sellers et al. 1989). A topography file containing the northing and easting of the plots at each site except for site 966 (2437-BBS), is available in the GRABBAG section of FIFE CD-ROM Volume 1 in the UNL directory, in file UNL_PLOT.T89. This file also includes slope, aspect, soil depth and vegetative height of the plots, for all sites.

The number and spatial distribution of the sites covered on each mission varied according to the specific mission objectives as established by the Science Steering Group. During IFC-5 the three primary sites (906, 916 and 926; sitegrids 2133-HLS, 4439-HLS, 8739-HLS, respectively) were measured on every mission to assure continuity.

Measurements were taken at the following locations:

SITEGRID	STN	NORTHING	EASTING	LATITUDE	LONGITUDE	ELEV	SLOPE	ASPECT
0847-HLS	929	4332344	714439	39 06 57	-96 31 11	418	1	TOP
1478-HLS	938	4331223	720664	39 06 15	-96 26 53	375	2	N
1511-HEL	107	4331080	707287	39 06 22	-96 36 10			
1916-HLS	902	4330282	708259	39 05 55	-96 35 30	351	2	N
1942-HLS	944	4330133	713414	39 05 46	-96 31 56	422	1	TOP
2123-HLS	905	4329866	709506	39 05 41	-96 34 39	405	1	TOP
2133-HLS	906	4329726	711604	39 05 34	-96 33 12	443	1	TOP
2330-HLS	908	4329314	711066	39 05 22	-96 33 35	424	5	E
2655-HLS	936	4328787	716070	39 05 00	-96 30 07	367	4	E
3129-HLS	912	4327822	710820	39 04 33	-96 33 47	431	14	E
3317-HLS	910	4327395	708485	39 04 22	-96 35 24	427	15	W
4268-HLS	932	4325633	718582	39 03 16	-96 28 26	420	1	TOP
4439-HLS	916	4325193	712773	39 03 06	-96 32 28	443	2	N
6469-HLS	923	4321189	718752	39 00 51	-96 28 25	440	3	NE
6735-HLS	913	4320652	712073	39 00 40	-96 33 03	385	1	BOTTOM
6912-HLS	924	4320111	707336	39 00 26	-96 36 20	397	2	N
8739-HLS	926	4316699	712845	38 58 31	-96 32 35	442	1	TOP

Spatial Coverage Map:

Not available.

Spatial Resolution:

The ground resolution of the data is 26.06 square meters at nadir (0.5 degrees FOV at 330 m AGL) and changed with view zenith angle.

Projection:

Not available.

Grid Description:

Not available.

Temporal Characteristics:

Missions were dependent on the availability of clear sky conditions.

Every site was not observed on every flight.

Temporal Coverage:

Missions were dependent on the availability of clear sky conditions. Every site was not observed on every flight. The overall period of coverage was from July 28, 1989, through August 8, 1989. Measurements were made on the following five dates:

July 28, 1989
August 4, 1989
August 6, 1989
August 7, 1989
August 8, 1989

Temporal Coverage Map:

Not available.

Temporal Resolution:

Observation time over each site was 2 to 5 minutes during which an average of 20 measurements were made (maximum of 150).

Data Characteristics:

The SQL definition for this table is found in the SE_HELO.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 (EESS-III) give the east (EE) and south (SS) cell number in a 100 x 100 array of 200 m square cells. The last 3 characters (III) are an instrument identifier.

STATION_ID
The station ID designating the location of the observations.

OBS_DATE
The date of the observations, in the format (DD-MMM-YY).

OBS_TIME
The start time of the observation in GMT. The format is (HHMM).

DURATION
The length of time data was collected at a site, in seconds. [seconds]

NUM_OBS
The number of observations averaged together.

VIEW_AZIM_ANG
The view azimuth angle (With North=0, East=90). [degrees from North]

VIEW_ZEN_ANG
The view zenith angle of the observations. With a nadir view=0 [degrees]

SOLAR_AZIM_ANG
The solar azimuth angle (With North=0, East=90). [degrees from North]

SOLAR_ZEN_ANG
The solar zenith angle. [degrees]

ALTITUDE
The helicopter altitude above ground level. [meters]

OBS_TYPE
A description of the area observed, FULL is the entire site, SRB is the same area as the ground surface radiance observations, WAB is the area upwind of the flux tower, SMT is a transect.

MISSION_ID
The mission identification for the helicopter flight.

WAVLEN
The wavelength of the observations. [microns]

REFL
The average percent reflectance. [percent]
Radiance values have been resampled using a cubic spline interpolation then ratioed with calibration panel data.

REFL_SDEV
The standard deviation of the reflectances. [percent]

FIFE_DATA_CRTFCN_CODE
The FIFE DATA Certification Code for the data, in the following format: CPI (Certified by PI), CPI-??? (CPI - questionable data). *

LAST_REVISION_DATE
data, in the format (DD-MMM-YY).

Note:

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 is "merged" from two separate receiving stations to eliminate transmission errors. CPI-??? Investigator thinks data item may be questionable.

Sample Data Record:

SITEGRID_ID	STATION_ID	OBS_DATE	OBS_TIME	DURATION	NUM_OBS
3317-HLS	910	08-AUG-89	2009	126	5
3317-HLS	910	08-AUG-89	2009	126	5
3317-HLS	910	08-AUG-89	2009	126	5
3317-HLS	910	08-AUG-89	2009	126	5

VIEW_AZIM_ANG	VIEW_ZEN_ANG	SOLAR_AZIM_ANG	SOLAR_ZEN_ANG
0	0	229.62	31.18
0	0	229.62	31.18
0	0	229.62	31.18
0	0	229.62	31.18

ALTITUDE	OBS_TYPE	MISSION_ID	WAVLEN	REFL	REFL_SDEV
305	FULL	890616B	.75	24.56	1.38
305	FULL	890616B	.48	4.35	.11
305	FULL	890616B	.475	4.3	.11
305	FULL	890616B	.47	4.26	.18

FIFE_DATA_CRTFCN_CODE	LAST_REVISION_DATE
CPI	27-NOV-90
CPI	27-NOV-90
CPI	27-NOV-90
CPI	27-NOV-90

8. Data Organization:

Data Granularity:

The number and spatial distribution of the sites covered on each mission varied according to the specific mission objectives as established by the Science Steering Group. The overall period of coverage was from July 28, 1989, through August 8, 1989.

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:

The algorithms and techniques to calculate the data in this data set are described in detail in Jackson et al., 1987, Markham et al., 1988 and Markham 1989. See these articles for this information.

Data Processing Sequence:

Processing Steps:

1. Preview raw helicopter instrument DN data via plots.
2. Preview surface calibration panel DN data via plots.
3. Convert DNs to radiance via calibration procedures outlined above.
4. Fit 5 nm spline to each data set for spectral calibration and delete data below 400 nm and above 1100 nm.
5. Divide helicopter radiances by cal panel radiances and convert to reflectance.

Processing Changes:

None known at this revision.

Calculations:

Special Corrections/Adjustments:

None reported at this revision.

Calculated Variables:

Reflectance.

Graphs and Plots:

None.

10. Errors:

Sources of Error:

Errors associated with the measurements can occur due to orientation of the SE-590. The angle of attack of the helicopter varies during flight. The motion of the helicopter cabin beneath the main rotor blades is analogous to a pendulum swinging. Swings resulting in off-nadir views up to 8 degrees off-nadir are possible. There has been no quantitative inquiry into this effect as only very small (estimated at 1 to 2 degrees) off-nadir-induced errors have been estimated in extreme cases. The instrument operator can normally wait for this motion to stop or can anticipate the position of the helicopter before triggering the instruments. The helicopter roll, pitch and yaw are dependent on atmospheric conditions, engine performance and aircrew fatigue. Off-nadir observations are especially questionable under less-than-optimal atmospheric conditions.

The shadowing caused by the SE-590 and the helicopter in measuring the "hot spot" area is another source of error. Variable cloud cover could be an error source with reflectance factors since the incoming radiation measurements were not made simultaneously with the surface measurements. Differences in irradiance between the reference panel location and the site being measured are an additional source of error (spatial distribution of atmospheric properties affecting irradiance).

The lack of correction of the calibration panel for non-Lambertian properties will also induce some errors.

There is also some debate on the amount of atmosphere in the pathlength between the helicopter and the surface. Recent inquiries have revealed absolute reflectance differences of up to 1 percent in the visible bands when at-sensor helicopter MMR radiances were corrected for atmospheric path length (of 300 m AGL) and processed for reflectance when using an atmospheric model. This has not been fully investigated and is still under investigation at the time of this writing.

The heterogeneity of the study site can also affect the measurements. This has been shown to be a potential problem when comparing airborne radiometric measurements to surface radiometric measurements.

There is also some question as to the radiometric fidelity of the data beyond 1000 nm. The use of two different instruments (one for target radiance and one for irradiance measurements) will result in some noise. The spline fit used for wavelength assignments to the sensor array channels is used to deal with some of these differences.

Although silicon detectors have very little temperature effects, there could be some noise induced due to this since there are no means of compensating for this with the SE-590.

Quality Assessment:

The SE-590 instrumentation and data have not been examined as closely as the MMR data. Calibration and characterization procedures for this instrument are still under investigation.

Data Validation by Source:

Comparisons have been made with the Surface Reflectances Measured by the PARABOLA, the Surface Reflectance Measured with a Mast-borne MMR data, and the SE-590 Reflectance Factors from GSFC and UNL. Plots of all helicopter SE-590 observations used in calculations of site averages have been made and examined for selected cases. The video tapes for these flights were reviewed as well. No obvious sources of error are indicated other than those listed above.

Confidence Level/Accuracy Judgment:

On days with variable cloud conditions the data should be used with caution. The AMS incoming solar radiation data at the site or nearby site should be consulted. On clear days the measurements fall within the precision of the instrument and errors that were discussed in previous sections.

Measurement Error for Parameters:

Not available at this revision.

Additional Quality Assessments:

Not available at this revision.

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:

Precise locations of the observations used to calculate a site average may not coincide with the exact locations of surface-based measurements.

Usage Guidance:

Before using reflectance factors the incoming radiation from the AMS station at the site or nearby site should be checked for possible cloud-induced error in reflectance factors. The cal panel procedure assumes spatially invariant irradiance conditions for the study area since it is at a fixed location. The data has not been corrected for the effects of the atmosphere beneath aircraft.

Any Other Relevant Information about the Study:

Not available.

12. Application of the Data Set:

This data set provides an intermediate scale of sampling between that of the surface measurements and the higher altitude aircraft and spacecraft multispectral imaging devices.

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:

SE-590 Reflectance Factors and Radiances Measured from a Helicopter are available on FIFE CD-ROM Volume 1. The CD-ROM filename is as follows:

\DATA\SUR_REFL\SE5_HELO\GRIDxxxx\yyddd\ydddgrid.Hnn

Where *xxxx* is the four digit code for the location within the FIFE site grid, *yy* is the last two digits of the year (e.g., 87 = 1987), and *ddd* is the day of the year, (e.g., 061 = sixty-first day in the year). 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.Hnn*, 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), *ddd* is the day of the year, and *nn* is the number of spectra during a day, when all the spectra are ordered chronologically and all spectra for a minute are in the same file. The content of each file is described in the *Data Characteristics Section*.

17. References:

Satellite/Instrument/Data Processing Documentation.

Barnes Engineering. 1982. Calibration and data book: Multispectral 8-channel radiometer. Barnes Engineering Company. Stamford, CT.

Journal Articles and Study Reports.

Blad, B.L., E.A. Walter Shea, C.J. Hays, and M.A. Mesarch. 1990. Calibration of field reference panel and radiometers used in FIFE 1989. AgMet Progress Report 90-3. Dept. of Agricultural Meteorology. Univ. of Nebraska-Lincoln. Lincoln, Nebraska. 68583-0728.

Jackson, R.D., S.M. Moran, P.N. Slater, and S.F. Biggar. 1987. Field calibration of reference reflectance panels. Remote Sensing of Environment. 17:103-108.

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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:

AGL Above Ground Level AMS Automatic Meteorological Station BPI Byte per inch CCT Computer Compatible Tape DAAC Distributed Active Archive Center EOSDIS Earth Observing System Data and Information System FIFE First ISLSCP Field Experiment FIS FIFE Information System IFC Intensive Field Campaign IFOV Instantaneous Field of View IRT Infrared Thermometer ISLSCP International Satellite Land Surface Climatology Project Mbps Megabyte per second MMR Modular Multiband Radiometer (8 channel radiometer) ORNL Oak Ridge National Laboratory SE590 Spectron Engineering 590 spectroradiometer URL Uniform Resource Locator WAB Wind Aligned Blob

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

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