Radiant Temp. Multiangle Data (FIFE)

Summary:

The Surface Temperatures Measured at Multiple Angles Data Set was collected at two locations within the northwest quadrant of the FIFE study area during July and August 1989. The data set contains hemispherical surface temperature, surface temperatures measured at several view zenith angles, and surface temperatures and at-view azimuth increments of 45 degrees. These data were collected using the Everest multiplexed infrared thermometers (IRT) Model 4000 and an Eppley Precision Infrared Radiometer Model PIR. Periodically measurements of the surface emissivity and incoming longwave radiation were also made.

The purpose of this study was to characterize bi-directional reflectance factor distributions, estimate surface albedo from bi-directional reflectance factor and radiance data, determine the variability of reflected and emitted fluxes in selected spectral wavebands as a function of topography, vegetative community and management practice, determine the influence of plant water status on surface reflectance factors, and determine sun angle affects on radiation fluxes.

Table of Contents:

1. Data Set Overview:

Data Set Identification:

Radiant Temp. Multiangle Data (FIFE).
(Surface Temperatures Measured at Multiple Angles).

Data Set Introduction:

The Surface Temperatures Measured at Multiple Angles Data Set contains hemispherical surface temperature, surface temperatures measured at several view zenith angles, and surface temperatures and at-view azimuth increments of 45 degrees. These data were collected using the Everest multiplexed infrared thermometers (IRT) Model 4000 and an Eppley Precision Infrared Radiometer Model PIR. Periodically measurements of the surface emissivity and incoming longwave radiation were also made.

Objective/Purpose:

1. Characterize bi-directional reflectance factor distributions in the solar principal plane for a tallgrass prairie.
2. Estimate surface albedo from bi-directional reflectance factor and radiance data.
3. Determine the variability of reflected and emitted fluxes in selected spectral wavebands as a function of topography, vegetative community and management practice.
4. Determine the influence of plant water status on surface reflectance factors.
5. Determine sun angle affects on radiation fluxes.

Summary of Parameters:

Hemispherical surface temperature, surface temperatures measured at nadir, 20, 40 and 60 degree view zenith angles, and surface temperatures and at view azimuth increments of 45 degrees.

Discussion:

The Everest multiplexed infrared thermometers (IRT) Model 4000 were mounted on an apparatus designed so that each IRT viewed the same surface area at a different view zenith angle. The arm (on which the IRT's were mounted) of the apparatus was moved at 45 degree increments so that view azimuth angles relative to the cardinal directions were measured. An Eppley Precision Infrared Radiometer Model PIR was also mounted to measure the surface temperature. Periodically measurements of the surface emissivity and incoming longwave radiation were made. These measurements were made at two locations within the northwest quadrant of the FIFE study area during July and August 1989.

Related Data Sets:

- Surface Reflectance Measured with a Mast-borne MMR.
- Leaf Optical Properties from UNL.
- SE-590 Reflectance Factors and Radiances from UNL.
- Surface Temperature from UNL.
- Surface Temperatures, Reflected and Emitted Radiation, and PAR from UNL.

- Incoming Longwave Radiation Data from UNL.
- Indirect Leaf Area Index Obtained from the UNL Light Wand.
- Leaf Area Index and PAR Determined from UNL Light Bar Measurements.
- Total Leaf Tissue Water Potential.
- Biophysical Properties of Vegetation.
- Vegetation Species and Cover Abundance.
- UNL Topography of Plots information in the GRAB-BAG (i.e., UNL_Plot.T87, UNL_Plot.T88, and UNL_Plot.T89). (Imagery)

FIS Data Base Table Name:

RADIANT_TEMP_MULTIANGLE_DATA.

2. Investigator(s):

Investigator(s) Name and Title:

Blaine L. Blad, Professor and Head
Elizabeth A. Walter-Shea, Asst. Professor

Roel Vining
University of Nebraska

Title of Investigation:

Measuring and Modeling Near-Surface Reflected and Emitted Radiation Fluxes at the FIFE Site.

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Requested Form of Acknowledgment.

The Surface Temperatures Measured at Multiple Angles were collected under the direction of R. Vining, B.L. Blad and E.A. Walter-Shea at the University of Nebraska. The dedicated efforts of C.J. Hays and M.A. Mesarch in the collection and preparation of these data is particularly appreciated.

3. Theory of Measurements:

Thermal radiant energy (**Rb**) is composed of an emitted component (**e * a * TS**4**) and a reflected component [**(1 - e) ILW**]:

Rb = a * Tirt4 = e * a * TS**4 + (1 - e) ILW**

where:

e = surface emissivity (unitless)
TS = surface temperature [deg. K]
ILW = incoming longwave radiation [w][m^-2]
a = Stefan-Boltzmann constant [w][m^-2][k^-4]
Tirt = temperature measurement from infrared thermometer [deg. K]

4. Equipment:

Sensor/Instrument Description:

The Everest infrared thermometer (IRT) multiplexed Model 4000 measures a temperature that is equal to:

T = (a * Rb)0.25** (Fuchs and Tanner 1966)

where:

a = Stefan-Boltzmann constant
Rb = emitted and reflected radiation
T = temperature measured by IRT

The Everest multiplexed infrared thermometer (IRT) Model 4000 has a spectral band-pass of 8-14 microns. The Model 4000 has two components: a temperature transducer and a multiplexer. The temperature transducer is 89 mm by 114 mm and weighs 0.8 Kg. The multiplexer is 159 mm by 114 mm by 159 mm and weighs 2.2 Kg. The field-of-view is 15 degrees.

The Eppley Precision Infrared Radiometer Model PIR measures an analog voltage response from the thermopile which is proportional to the emitted and reflected radiation (**Rb**) in the 4 to 50 micron region. The PIR has a hemispherical field-of-view. The PIR also produces an analog voltage response from thermistors embedded in the dome and near the thermopile which are used to correct for any heating of the thermopile and differentials between the dome and the thermopile (Albrecht and Cox 1977).

Collection Environment:

Ground-based.

Source/Platform:

The Everest multiplexed infrared thermometers (IRT) Model 4000 were mounted on an arm of an apparatus at view zenith angles of nadir, 20, 40 and 60 degrees. The nadir IRT was 3.3 m above the soil surface. The radius of the arm was 3.3 m which allowed all of the IRT's to see approximately the same surface area. The arm was rotated at 45 degree increments relative to the cardinal directions to obtain measurements at different view azimuth angles.

The Eppley Precision Radiometer Model PIR was mounted on a frame so that it was suspended 0.8 m above the top of the soil surface.

Source/Platform Mission Objectives:

Not applicable.

Key Variables:

Surface temperatures at different view zenith and azimuth angles and a hemispherical surface temperature.

Principles of Operation:

The Everest Infrared Thermometer Multiplexed Model 4000 measures an integrated emitted and reflected radiation value from a target over a specific field-of-view. This radiation is related to the surface temperature by the Stefan-Boltzmann law. For a further description of the basic principles of infrared thermometry see Fuchs and Tanner (1966). For the specifics of the aforementioned instrument see the instruction manual (Anonymous 1986).

The Eppley Precision Infrared Radiometer Model PIR is a modification of the Eppley Precision Spectral Pyranometer with the glass dome replaced by a silicon hemisphere. Two thermistors are embedded, one in the dome and one near the thermopile. The one near the thermopile is used to temperature correct a direct reading from the thermopile. The two thermistors are also used to provide a temperature correction for differences between the dome and thermopile temperatures. The Eppley PIR is further described in Albrecht and Cox (1977).

Sensor/Instrument Measurement Geometry:

The Everest Multiplexed Infrared Thermometers (IRT) Model 4000 were mounted on an apparatus which allowed each IRT to view approximately the same surface area, regardless of the view zenith angle or azimuth angle. IRT's at view zenith angles of nadir, 20, 40 and 60 degrees were mounted on a movable arm on the apparatus. The arm had a radius of 3.3 m. The arm was rotated in 45 degree increments to obtain different view zenith angles. The nadir IRT was located at 3.3 m above the soil surface. The IRT has a 15 degree field-of-view.

The Eppley Precision Infrared Radiometer Model PIR was suspended on a frame 0.8 m above the soil surface. The PIR has a hemispherical field-of-view.

Manufacturer of Sensor/Instrument:

Everest Interscience Inc.
P.O. Box 3640
Fullerton, California 92634-3640
(714) 992-4461

The Eppley Laboratory, Inc.
12 Sheffield Ave.
Newport, R.I. 02840
(401) 847-1020

Calibration:

A pre-season calibration was performed on the Everest Multiplexed Infrared Thermometers (IRT) Model 4000. The procedure used is described in Blad et al. (1990). Daily stability checks were made using an Everest Model 1000 calibration source.

A pre-season calibration was performed on the Eppley Infrared Radiometer by Eppley. See Eppley's Instruction Manual for specifics (Anonymous).

Specifications:

An attempt was made to calibrate the Eppley Precision Infrared Radiometer Model PIR for differences in the dome thermistor temperature and the thermopile thermistor temperature using the procedure of Albrecht and Cox (1977). Due to equipment and laboratory limitations the calibration constant obtained was erroneous. Smith (1988) suggested that a calibration constant of k = 5 (used in Equation 3 in the *Formulae Section*) for this correction is acceptable.

Tolerance:

The Everest Multiplexed Infrared Thermometer Model 4000 specifications are an accuracy of +/- 0.5 degree C, a repeatability of +/- 0.1 degree C and a resolution of +/- 0.1 degree C.

When the calibration derived coefficients are applied to the calibration data set (i.e., not an independent data set) comparisons of the corrected instrument reading to the blackbody source temperature show that the mean bias errors ranged from 0.0 to -0.2 degree C and the mean relative errors ranged from -0.8 to 3.9%.

The Eppley Precision Infrared Radiometer Model PIR accuracy is theoretically 5% (Albrecht and Cox 1977).

Frequency of Calibration:

A pre-season calibration was performed on the Everest Multiplexed Infrared Thermometer (IRT) Model 4000. Daily stability checks were made using an Everest Model 1000 calibration source.

A pre-season calibration was performed on the Eppley Precision Infrared Radiometer Model PIR.

Other Calibration Information:

When the calibration derived coefficients for the Everest Multiplexed Infrared Thermometer Model 4000 are applied to the calibration data set (i.e., not an independent data set) comparisons of the corrected instrument reading to the blackbody source temperature show that the mean bias errors ranged from -0.2 to 0.1 degree C and the mean relative errors ranged from -1.0 to 3.9 %. When calibration derived coefficients were not applied to the same data set comparisons to the blackbody source show that the mean bias errors ranged from -0.8 to 1.0 degree C and the means relative errors ranged from -3.2 to 23.0%.

5. Data Acquisition Methods:

Four Everest Multiplexed Infrared Thermometers (IRT) Model 4000 were mounted on an apparatus at view zenith angles of nadir, 20, 40 and 60 degrees. The apparatus had a movable arm that was allowed different view azimuth angles. The view azimuth angles were with respect to the cardinal directions and were at 45 degree increments with 0 defined as when the IRT's faced to the north and 90 as when the IRT's faced to the east. The movable arm had a radius of 3.3 m which allowed all of the IRT's to view approximately the same surface. Measurements were made periodically throughout the day. Measurements were also made with an inverted Eppley Precision Radiometer Model PIR that was suspended 0.8 m above the soil surface at each time measurements were made with the IRT's at a particular view azimuth angle. Periodically the incoming longwave radiation was also measured using the aluminum plate method described by Blad and Rosenberg (1976).

6. Observations:

Data Notes:

Not available.

Field Notes:

Not available.

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:

These data were collected at the following two locations within the FIFE study area:

SITEGRID	STN	NORTHING	EASTING	LATITUDE	LONGITUDE	ELEV	SLOPE	ASPECT
2133-ARC	906	4329726	711604	39 05 34	-96 33 12	443	1	TOP
4439-ARC	916	4325193	712773	39 03 06	-96 32 28	443	2	N

SITEGRID	SLOPE	ASPECT
2133-ARC	1	TOP
4439-ARC	2	N

Spatial Coverage Map:

Not available.

Spatial Resolution:

The field-of-view is 15 degrees, instruments were mounted at 3.3 meters above the soil surface.

Projection:

Not available.

Grid Description:

Not available.

Temporal Characteristics:

Temporal Coverage:

Measurements were made on the following 8 days between July 12 and August 10, 1989.

	OBS_DATE	OBS_DATE
12-JUL-89	06-AUG-89	
28-JUL-89	07-AUG-89	
01-AUG-89	08-AUG-89	

04-AUG-89   10-AUG-89

Measurements were made periodically throughout each day.

Temporal Coverage Map:

Not available.

Temporal Resolution:

Measurements at the 4 view zenith angles and 8 view azimuth angles were made in less than five minutes.

Data Characteristics:

The SQL definition for this table is found in the IRT_MULT.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 the east (EE) 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 time that the observation was taken in GMT. The format is (HHMM).			

PLOT_NUM The identification number assigned to the subsite where the observations were made.		
VIEW_AZIM_ANGLE The view azimuth angle, where 0 is with the instrument looking from the north and 90 is with the instrument looking from the east.		[degrees from North]
SURF_TEMP_0_VZA The surface temperature measured by the Everest Infrared Thermometer with a 0 degree view zenith angle.		[degrees Kelvin]
SURF_TEMP_20_VZA The surface temperature measured by the Everest Infrared Thermometer with a 20 degree view zenith angle.		[degrees Kelvin]
SURF_TEMP_40_VZA The surface temperature measured by the Everest Infrared Thermometer with a 40 degree view zenith angle.		[degrees Kelvin]
SURF_TEMP_60_VZA The surface temperature measured by the Everest Infrared Thermometer with a 60 degree view zenith angle.		[degrees Kelvin]
SURF_TEMP_HEMIS The hemispheric surface temperature measured by the Eppley Precision Infrared Radiometer.		[degrees Kelvin]
FIFE_DATA_CRTFCN_CODE The FIFE 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).
```

Footnote:

Decode the FIFE_DATA_CRTFCN_CODE field as follows:

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	PLOT_NUM	VIEW_AZIM_ANGLE
4439-ARC	916	12-JUL-89	1627	1	180.00
4439-ARC	916	12-JUL-89	1628	1	225.00
4439-ARC	916	12-JUL-89	1628	1	270.00
4439-ARC	916	12-JUL-89	1629	1	315.00

SURF_TEMP_0_VZA	SURF_TEMP_20_VZA	SURF_TEMP_40_VZA	SURF_TEMP_60_VZA
307.06	305.32	305.05	304.15
307.47	305.94	305.58	304.57
306.30	305.93	305.09	304.43
306.22	306.95	305.51	305.05

SURF_TEMP_HEMIS	FIFE_DATA_CRTFCN_CODE	LAST_REVISION_DATE
305.32	CPI	15-DEC-93
305.32	CPI	15-DEC-93
305.32	CPI	15-DEC-93
305.32	CPI	15-DEC-93

8. Data Organization:

Data Granularity:

Measurements were made on 8 days between July 12 and August 10, 1989. Measurements were made periodically throughout a day.

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:

Tirtc = a + b * Tirt [1]

where:

Tirtc = calibration corrected temperature measurement [deg. C]
a = calibration coefficient [deg. C]
b = calibration coefficient (unitless)
Tirt = temperature measurement from IRT [deg. C]

TSirt = {a * (Tirtc + 273.16)4 + (1 - e) * ILW] / (e * a)}**.25 [2]**

where:

e = surface emissivity (unitless)
a = Stefan-Boltzmann constant [w][m^-2][k^-4]
ILW = incoming longwave radiation [w][m^-2]
TSirt = surface temperature [deg. K]

E = n * Vtherm + a * Ttherm4 - k * a (Tdome**4 - Ttherm**4) [3]**

where:

n = calibration coefficient [w][m^-2][mv^-1]
k = 5 (unitless)
Vtherm = voltage from direct thermopile output [mv]
Tdome = temperature of the dome thermistor [deg. K]
Ttherm = temperature of the thermopile thermistor [deg. K]

TSpir = {E + (1 - e)* ILW] / (e * a)}.25 [4]**

where:

e = surface emissivity (unitless)
a = Stefan-Boltzmann constant [w][m^-2][k^-4]
ILW = incoming longwave radiation [w][m^-2]
TSpir = surface temperature [deg. K]

Derivation Techniques and Algorithms:

The surface temperature was calculated using the calibration corrected temperature measurement, incoming longwave radiation (**ILW**) and surface emissivity values (Eqs. 2 and 4).

Values for incoming longwave radiation were measured using the aluminum plate method described by Blad and Rosenberg (1976).

Surface emissivity measurements were periodically made using a modified pop-tent method described by Fuchs and Tanner (1966).

Data Processing Sequence:

Processing Steps:

The calibration coefficients are not available at this revision. Equation 1 is used to correct the temperature measurement of the instrument using calibration-derived coefficients (Blad et al. 1990). The calibration corrected temperature measurement of the instrument, incoming longwave radiation and surface emissivity values are used to calculate surface temperature using Equation 2 (Blad and Rosenberg 1976).

Equation 3 is used to calculate the outgoing longwave radiation from the Eppley Precision Infrared Radiometer Model PIR. Equation 4 is used to calculate the surface temperature.

Processing Changes:

Not applicable.

Calculations:

Special Corrections/Adjustments:

The surface temperatures measured with the Eppley Precision Radiometer were averaged over the 8 azimuth angles measured with the IRT's.

Calculated Variables:

- Calibration corrected temperature measurement,
- Surface temperature,

- Surface emissivity, and
- Outgoing longwave radiation.

Graphs and Plots:

None.

10. Errors:

Sources of Error:

Not available at this revision.

Quality Assessment:

Data Validation by Source:

Not available at this revision.

Confidence Level/Accuracy Judgment:

Not available at this revision.

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:

Not available.

Usage Guidance:

Not available.

Any Other Relevant Information about the Study:

Not available.

12. Application of the Data Set:

This data set can be used to characterize bi-directional reflectance factor distributions, estimate surface albedo from bi-directional reflectance factor and radiance data, study the variability of reflected and emitted fluxes in selected spectral wavebands as a function of topography, vegetative community and management practice, study the influence of plant water status on surface reflectance factors, and study sun angle affects on radiation fluxes.

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:

The Surface Temperatures Measured at Multiple Angle data are available on FIFE CD-ROM Volume 1. The CD-ROM filename is as follows:

\DATA\SUR_REFL\IRT_MULT\GRIDxxxx\ydddgrid.RTM

Where *xxxx* is the four digit code for the location within the FIFE site grid. 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 .RTM for this data set.

17. References:

Satellite/Instrument/Data Processing Documentation.

Anonymous. Instrumentation for the measurement of the components of solar and terrestrial radiation. The Eppley Laboratory, Inc. Newport, R.I.

Anonymous. 1986. Multiplexed Model 4000 Infrared Temperature transducers operating manual. Everest Interscience, Inc. Fullerton, CA (1986).

Journal Articles and Study Reports.

Albrecht, B. and S.K. Cox. 1977. Procedures for improving pyrgeometer performance. Journal of Applied Meteorology. 16:188-197

Blad, B.L. and J.J. Rosenberg. 1976. Measurement of crop temperature by leaf thermocouple, infrared thermometry and remotely sensed thermal imagery. Agronomy Journal. 68:635-641.

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. Department of Agricultural Meteorology. University of Nebraska-Lincoln. Lincoln, Nebraska. 68583-0728.

Fuchs, M. and C.B. Tanner. 1966. Infrared thermometry of vegetation. Agronomy Journal. 58:5976-601.

Smith, E. 1988. Personal communication. Department of Meteorology. Florida State University. Tallahassee, Florida.

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:

DAAC Distributed Active Archive Center EOSDIS Earth Observing System Data and Information System FIFE First ISLSCP Field Experiment FIS FIFE Information System IRT Infrared Thermometer ISLSCP International Satellite Land Surface Climatology Project ORNL Oak Ridge National laboratory PIR Precision Infrared Radiometer UNL University of Nebraska - Lincoln URL Uniform Resource Locator

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

20. Document Information:

May 11, 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:

July 12, 1996.

Document ID:

ORNL-FIFE_IRT_MULT.

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