Helicopter MMR Reflectance Data (SNF)

Summary:

A major aspect of the ground data collection effort in the SNF during the summers of 1983 and 1984 was the acquisition of helicopter canopy reflectance measurements. Canopy measurements were made at numerous sites with a helicopter-mounted Barnes modular multiband radiometer (MMR). MMR data were collected on ten dates in 1983 and eight dates in 1984. An additional Barnes radiometer was used to make simultaneous reference panel measurements. The canopy reflectance was derived from the canopy and reference panel measurements. All canopy and reference panel measurements were made under clear sky conditions. A majority of the helicopter measurements were taken at nadir view, although some off-nadir view angle measurements were taken primarily over black spruce and aspen sites.

The reflectance factor is the ratio of radiant flux of the canopy measurement to that of the reference or calibration panel. Another component to be considered is atmospheric scatter, especially for aircraft measurements taken at higher altitudes. The amount of atmospheric scattering can be determined by using reflectance measurements of water targets. Reflectance measurements over water targets are included for all acquisitions in 1983. No water target measurements were taken during the 1984 field campaign.

The summarized MMR data for both years, 1983 and 1984, are included in this data set. Fields include site ID number, number of observations averaged, code for altitude of instrument above the canopy, the time at which observations begin, the time at which observations end, sun zenith angle, sun azimuth angle, and reflectance for each of the bands (with standard deviations included within parenthesis). All measurements were taken at nadir, except where otherwise indicated. In 1984, MMR data were collected using off nadir view angles to measure the bi-directional reflectance characteristics of the forests.

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1. Data Set Overview:

Data Set Identification:

Helicopter MMR Reflectance Data (SNF)

Data Set Introduction:

A major aspect of the ground data collection effort in the SNF during the summers of 1983 and 1984 was the acquisition of helicopter canopy reflectance measurements. Canopy measurements were made at numerous sites with a helicopter-mounted Barnes modular multiband radiometer (MMR). The MMR measures on the same wavelength bands as the Thematic Mapper Simulator. MMR data were collected on ten dates in 1983 and eight dates in 1984. An additional Barnes radiometer was used to make simultaneous reference panel measurements. The canopy reflectance was derived from the canopy and reference panel measurements. All canopy and reference panel measurements were made under clear sky conditions. A majority of the helicopter measurements were taken at nadir view, although some off-nadir view angle measurements were taken primarily over black spruce and aspen sites. The acquisition dates in 1983 were: May 5th and 16th, June 9th, July 12th and 13th, August 12th and 14th, and October 6th, 26th and 27th. The 1984 acquisition dates were: May 18th and 28th, June 3rd, August 2nd, 3rd and 16th, and September 16th and 23rd.

Objective/Purpose:

Not available.

Summary of Parameters:

Canopy reflectance, bi-directional reflectance, NDVI.

Discussion:

Reference panel measurements were used to convert voltages measured by the canopy instrument to reflectance factors. The reference panel was a surface painted with barium sulfate. The reflectance factor is the ratio of radiant flux of the canopy measurement to that of the reference or calibration panel. Another component to be considered is atmospheric scatter, especially for aircraft measurements taken at higher altitudes. The amount of atmospheric scattering can be determined by using reflectance measurements of water targets. Assuming the reflectance of water is zero, reflectance measured at these targets is a measure of the amount of atmospheric scatter. Reflectance measurements over water targets are included for all acquisitions in 1983. No water target measurements were taken during the 1984 field campaign.

During the 1983 field campaign, the helicopter measurements were usually taken at an altitude of 400 feet, with a few observations at 200 and 300 feet. At an altitude of 400 feet and a radiometer field of view of 15 degrees, the canopy area being sensed is approximately 105 feet in diameter. In 1984, most measurements were taken at an altitude of 600 feet. To measure the same canopy area at this altitude, the field of view was reduced to 10 degrees, although on two dates this was reduced further to 6 degrees. At 600 feet, the reduction of the field of view from 10 to 6 degrees reduces the canopy area being sensed from 105 to 63 feet in diameter.

There are approximately 317 observations made over 105 different sites in 1983 and about 160 observations made over 29 sites in 1984. Each set of reflectance values for a site is actually the mean of observations taken over a given time interval and generally average between 16 and 20 separate measurements.

The summarized MMR data for both years, 1983 and 1984, are included in this data set. Fields include site ID number, number of observations averaged, code for altitude of instrument above the canopy (in hundreds of feet), the time (GMT) at which observations begin, the time at which observations end (each a six digit number, the first two correspond to hours, the second and third two corresponding to minutes and seconds, respectively), sun zenith angle, sun azimuth angle, and reflectance for each of the bands (with standard deviations included within parenthesis). Values of -1.0 signify missing data. All measurements were taken at nadir, except where otherwise indicated.

In 1984, MMR data were collected using off nadir view angles to measure the bi-directional reflectance characteristics of the forests.

Related Data Sets:

Not available.

2. Investigator(s):

Investigator(s) Name and Title:

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Bennington College

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Title of Investigation:

Biophysical, Morphological, Canopy Optical Property, and Productivity Data on the Superior National Forest.

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3. Theory of Measurements:

Not available.

4. Equipment:

Sensor/Instrument Description:

Collection Environment:

Airborne.

Source/Platform:

Field Investigation.

Source/Platform Mission Objectives:

Not available.

Key Variables:

Canopy reflectance, bi-directional reflectance, NDVI.

Principles of Operation:

Not available.

Sensor/Instrument Measurement Geometry:

All measurements were taken at nadir, except where otherwise indicated. In 1984, MMR data were collected using off nadir view angles to measure the bi-directional reflectance characteristics of the forests.

Manufacturer of Sensor/Instrument:

Not available.

Calibration:

Not available.

5. Data Acquisition Methods:

Not available.

6. Observations:

Data/Field Notes:

Not available.

7. Data Description:

Spatial Characteristics:

There are approximately 317 observations made over 105 different sites in 1983 and about 160 observations made over 29 sites in 1984. Each set of reflectance values for a site is actually the mean of observations taken over a given time interval and generally average between 16 and 20 separate measurements.

Temporal Characteristics:

Temporal Coverage:

MMR data were collected on ten dates in 1983 and eight dates in 1984.

Temporal Coverage Map:

Not available.

Temporal Resolution:

The acquisition dates in 1983 were: May 5th and 16th, June 9th, July 12th and 13th, August 12th and 14th, and October 6th, 26th and 27th. The 1984 acquisition dates were: May 18th and 28th, June 3rd, August 2nd, 3rd and 16th, and September 16th and 23rd.

Data Characteristics:

Variable Name/ Long Name	SAS Type	Generic Type	Description
1 site_id SITE_ID	8	NUMBER(4,0)	"Site ID"

2	obs_datc	OBS_ DATE	$ 12	DATE "Obs. date (dd-mmm-yy)"
3	st_gmt	START_GMT	$ 8	NUMBER(4,0) "Start time, GMT (hhmm)"
4	end_gmt	END_GMT	$ 8	NUMBER(4,0) "End time, GMT (hhmm)"
5	height	HEIGHT	8	NUMBER(5,0) "Altitude of helicopter above ground level, in hundreds of feet (0=100 feet, 2=200 feet, 3=300 feet)"
6	sze	SOLAR_ZEN	8	NUMBER(5,2) "Average solar zenith angle in decimal degrees relative to the observer"
7	saz	SOLAR_AZM	8	NUMBER(5,2) "Average solar azimuth angle in decimal degrees relative to the observer"
8	vze	VIEW_ZEN	8	NUMBER(5,2) "View zenith angle in decimal degrees relative to the observer"
9	vaz	VIEW_AZM	8	NUMBER(5,2) "View azimuth angle in decimal degrees relative to the observer"
10	refl1	REFL1	8	NUMBER(5,4) "Average percent reflectance in MMR channel 1"
11	sd1	SD1	8	NUMBER(5,4) "Standard deviation of reflectance in MMR channel 1"
12	refl2	REFL2	8	NUMBER(5,4) "Average percent reflectance in MMR channel 2"

13 sd2 SD2 8 NUMBER(5,4)
"Standard deviation of reflectance
in MMR channel 2"

---

14 refl3 REFL3 8 NUMBER(5,4)
"Average percent reflectance in
MMR channel 3"

---

15 sd3 SD3 8 NUMBER(5,4)
"Standard deviation of reflectance
in MMR channel 3"

---

16 refl4 REFL4 8 NUMBER(5,4)
"Average percent reflectance in
MMR channel 4"

---

17 sd4 SD4 8 NUMBER(5,4)
"Standard deviation of reflectance
in MMR channel 4"

---

18 refl5 REFL5 8 NUMBER(5,4)
"Average percent reflectance in
MMR channel 5"

---

19 sd5 SD5 8 NUMBER(5,4)
"Standard deviation of reflectance
in MMR channel 5"

---

20 refl6 REFL6 8 NUMBER(5,4)
"Average percent reflectance in
MMR channel 6"

---

21 sd6 SD6 8 NUMBER(5,4)
"Standard deviation of reflectance
in MMR channel 6"

---

22 refl7 REFL7 8 NUMBER(5,4)
"Average percent reflectance in
MMR channel 7"

---

23 sd7 SD7 8 NUMBER(5,4)
"Standard deviation of reflectance
in MMR channel 7"

---

24 num_obs NUM OBS 8 NUMBER(4,0)

"Number of observations acquired by
the helicopter MMR to arrive at the
average reflectance value"

Sample Data Record:

site_id	obs_datc	st_gmt	end_gmt	height	sze	saz	vze	vaz	
refl1	sd1	refl2	sd2	refl3	sd3	refl4	sd4	refl5	
1	"15-MAY-83"	"1936"	"1937"	1	35	220.5	0	0	0
0	0.0307	0.0008	0.0265	0.0015	0.1721	0.0102	0.1837		
2	"15-MAY-83"	"1942"	"1944"	1	35.5	222.5	0	0	0
0	0.0252	0.0007	0.0187	0.0005	0.1108	0.0026	0.1356		
14	"15-MAY-83"	"1945"	"1946"	1	36	223.31	0	0	0
0	0.0263	0.0008	0.0194	0.0007	0.1137	0.0017	0.1384		
15	"15-MAY-83"	"1949"	"1950"	2	36	225	0	0	0
0	0.0266	0.0004	0.0197	0.0003	0.1189	0.0016	0.1409		
15	"15-MAY-83"	"1951"	"1951"	3	36	225	0	0	0
0	0.0253	0.0006	0.0185	0.0005	0.1114	0.0012	0.1329		
15	"15-MAY-83"	"1952"	"1953"	4	37	226	0	0	0
0	0.0246	0.0007	0.0179	0.0005	0.1098	0.003	0.1296		
23	"15-MAY-83"	"1955"	"1955"	1	37	227	0	0	0
0	0.0057	0.0003	0.0048	0.0002	0.003	0.0003	0.0016		
3	"15-MAY-83"	"2000"	"2000"	3	38	229	0	0	0
0	0.0563	0.0022	0.064	0.0026	0.1586	0.0067	0.2445		
16	"15-MAY-83"	"2005"	"2005"	1	38	230	0	0	0
0	0.0482	0.0009	0.0517	0.0017	0.1433	0.0023	0.2121		
3	"15-MAY-83"	"2008"	"2008"	2	39	231	0	0	0
0	0.059	0.0009	0.0664	0.0009	0.1686	0.0023	0.2538		
3	"15-MAY-83"	"2009"	"2010"	4	39	231.44	0	0	0
0	0.0558	0.0013	0.0643	0.0018	0.153	0.0029	0.24		
4	"15-MAY-83"	"2015"	"2016"	1	40	233.25	0	0	0
0	0.0315	0.0018	0.0251	0.0023	0.1937	0.0048	0.192		
6	"15-MAY-83"	"2021"	"2022"	1	40	235	0	0	0
0	0.0625	0.0024	0.0802	0.003	0.1424	0.0023	0.2508		
17	"15-MAY-83"	"2027"	"2028"	1	41	237	0	0	0
0	0.0566	0.0017	0.0697	0.0018	0.1476	0.0032	0.2587		
5	"15-MAY-83"	"2031"	"2031"	1	42	238	0	0	0
0	0.0462	0.0018	0.0514	0.003	0.1454	0.0028	0.2264		
24	"15-MAY-83"	"2034"	"2034"	1	42	239	0	0	0
0	0.0062	0.0001	0.0039	0.0001	0.002	0.0001	0.001		
26	"15-MAY-83"	"2119"	"2119"	1	49	250	0	0	0
0	0.0076	0.0003	0.0047	0.0003	0.0023	0.0003	0.0011		
13	"15-MAY-83"	"2123"	"2124"	1	50	251.75	0	0	0
0	0.0247	0.0011	0.0201	0.0008	0.1474	0.0071	0.1583		
12	"15-MAY-83"	"2130"	"2130"	1	51	253	0	0	0
0	0.0414	0.0022	0.0458	0.0036	0.1474	0.0057	0.1939		

Footnote:

For presentation in this document, some padding blanks may have been eliminated between columns in the Sample Data Record. Due to the many fields in this data file, these columns will wrap while viewing. The actual data files, however, are column delimited with an adequate record length to prevent wrapping. See the *Data Format Section* for conventions used for missing data values in the data file.

8. Data Organization:

Data are sorted by observation date (obs_datc) and start time (st_gmt). Key fields in each record are site_id and obs_datc.

Data Granularity:

This data set consists of a single ASCII file containing canopy reflectance measurements for 1983 and 1984.

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

Data Format:

The data files associated with this data set consist of numeric and character fields of varying lengths aligned in columns.

The first row of each data file contains the 8 character SAS variable name that links to the data format definition file.

Character fields are enclosed in double quotes and numeric fields are listed without quotes.

Missing data values can be of two varieties:

1. Values that were identified as missing in the original data files. Missing numeric values of this type are identified in these data as -999.
2. Those holes that were created as a result of combining files that contained a slightly different variable set. Missing values of this type are identified in these data files as empty double quotes for character fields and a single period, '.' for numeric fields.

9. Data Manipulations:

Not available.

10. Errors:

Sources of Error:

Not available.

Quality Assessment:

Data Validation by Source:

Not available.

Confidence Level/Accuracy Judgment:

Not available.

Measurement Error for Parameters:

Not available.

Additional Quality Assessments:

Not available.

Data Verification by Data Center:

The Superior National Forest data were received from the Goddard Space Flight Center in three media:

- As data dumps from the original Oracle SNF database maintained by GSFC, transferred electronically from the GSFC system to the ORNL system;
- As ASCII files that mirrored the tables published in the Tech Memo; and
- As hard copy (Tech Memo).

Data from both electronic sources were input into SAS by ORNL DAAC data management staff and compared using computer code developed to process the SNF data. In many cases, the data values from both sources were found to be identical. In some cases, however, differences were identified and the providers of the data were consulted to resolve inconsistencies.

Additionally, some variable columns were available in one source, but not the other for various reasons. For example, some calculated variables/columns were provided in the ASCII files (reflecting the Tech Memo tables) that were not stored in the Oracle database for purposes of space conservation.

For similar reasons, coded values were used for many of the site and species identifier variables. A separate reference table was provided to link the coded variable with its definition (e.g., the SPECIES_REF file and the SITE_REF file).

The database produced by the ORNL DAAC is a hybrid product that is a composite of data and information extracted from all three source media. In data sets where coded variables were included, the code definition variables have been added to improve usability of the data set as a stand-alone product.

Therefore the ASCII files that are available through the ORNL DAAC on-line search and order systems are output from a data set that is a product of the essential core of numeric data provided by the data source (GSFC), augmented with additional descriptive information provided by GSFC and reorganized by the ORNL DAAC into a data structure consistent with other similar data sets maintained by the ORNL DAAC.

11. Notes:

Limitations of the Data:

Not available.

Known Problems with the Data:

None known at this revision.

Usage Guidance:

Not available.

Any Other Relevant Information about the Study:

None.

12. Application of the Data Set:

Not available.

13. Future Modifications and Plans:

None available at this revision.

14. Software:

Not available.

15. Data Access:

Contact Information:

ORNL DAAC User Services
Oak Ridge National Laboratory
Telephone: (865) 241-3952
Fax: (865) 574-4665
E-mail: ornldaac@ornl.gov

Data Center Identification:

ORNL Distributed Active Archive Center
Oak Ridge National Laboratory
Telephone: (865) 241-3952
Fax: (865) 574-4665
E-mail: ornldaac@ornl.gov

Procedures for Obtaining Data:

Users may order data by telephone, electronic mail, or fax. Data are available via FTP or on CD-ROM. Data are also available via the World Wide Web at http://daac.ornl.gov .

Data Center Status/Plans:

The Superior National Forest 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:

Available via FTP or on CD-ROM.

17. References:

Not available.

Archive/DBMS Usage Documentation.

Contact the ORNL DAAC, Oak Ridge, Tennessee (see the *Data Center Identification Section*).

18. Glossary of Terms:

A general glossary is located at EOSDIS Glossary.

19. List of Acronyms:

MMR Multiband radiometer NDVI Normalized Difference Vegetation Index URL Uniform Resource Locator

A general list of acronyms is available at http://cdiac.ornl.gov/pns/acronyms.html.

20. Document Information:

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