

*LARS Contract Report*

*100178*

LACIE FIELD MEASUREMENTS  
DATA LIBRARY CATALOG  
VOLUME III  
1976-77 CROP YEAR



*National Aeronautics and Space Administration*  
**LYNDON B. JOHNSON SPACE CENTER**  
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LACIE FIELD MEASUREMENTS

DATA LIBRARY CATALOG

VOLUME III

1976-77 CROP YEAR

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## PREFACE

The LACIE Field Measurements program, under the sponsorship of the Earth Observations Division, NASA/Johnson Space Center, was initiated in the Fall of 1974 to acquire, process, and make available to researchers agricultural remote sensing data. As a result, one of the most comprehensive data sets for remote sensing research has been assembled. Information describing the test sites, sensors, data acquisition and processing procedures is contained in the project plan.

The Field Measurements Data Library Catalog provides information on what data is available from the library. The catalog is divided into separate volumes - one for each crop year during which data were collected. The Field Measurements data library facility is located at the Laboratory for Applications of Remote Sensing (LARS), Purdue University.

Volume III provides information for the 1976-77 crop. Periodically, as new data is added to the library, the Data Catalog - Volume III will be updated.

Technical information on the data may be obtained

at [www.lars.purdue.edu/home/FRData/field\\_research\\_data.html](http://www.lars.purdue.edu/home/FRData/field_research_data.html).

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## 1. INTRODUCTION

The general organization of the Field Measurements Data Library is illustrated in Figure 1-1. The purpose of this document is to provide information to researchers describing by site, date, and sensor, the data contained in the library.

Each volume of the data catalog consists of four levels with each level including an increasing amount of specificity describing individual items of data.

The first level is the Summary, the second level is the Record, the third is the Index, and the fourth level is the Listing.

Section 2, Summary of Field Measurements Data, summarizes the data collected by the major sensor types for the missions over each of the three test sites.

Section 3, Record of Field Measurements Data, is a record of the date that data were collected over the test site and a record of which data has been processed to the point that it is available for users. This section is organized according to test site and location of data collection. Finney County, Kansas and Williams County, North Dakota each have three data collection locations - the intensive test site (ITS), the agriculture experiment station (AES), and a modeling field. The Hand County test site has only one data collection location - the intensive test site.

Section 4, Index of Field Measurements Data, is an index of the data collected organized by sensor type, i.e. Landsat, aircraft, FSS-S191H, FSAS-VISS, Exotech 20C, and Exotech 100. The Landsat data is listed by site and date; the aircraft data by site, date, and flight line; the FSS data by site, date and flight line; the truck-mounted spectrometer data is listed by site, date and experiment; and the tripod-mounted radiometer data is listed by site, date, and time.

The fourth level of the data catalog, a computer printout, is a listing of the information (i.e., observation number, location, date, time, scene type, instrument) required to access individual spectra. It is not included in this document, but is available upon request from Purdue/LARS.

Appendix I contains information pertaining to the location of the test sites and flight lines. Appendix II describes the treatments (plots) for which data were acquired on the agriculture experiment stations. Appendix III briefly describes the supporting agronomic, meteorological, and atmospheric measurements. Appendix IV gives a summary of the LACIE Field Measurements sensor data specifications and operational characteristics.

The formats of the data are either imagery, hard copy outputs (as tables), or 9-track computer compatible tapes (CCT's). The CCT's for the Landsat and aircraft multispectral scanner data are in LARSYS format. These data are approximately linearly related to the scene radiance, i.e., the data have not been altered from the initial processing performed at the respective institutions which operated the sensors. The CCT's containing the spectrometer or interferometer data (FSS, FSAS, and Exotech 20C) are in EXOSYS format. These data are calibrated in bidirectional reflectance factor. Also, each observation on the EXOSYS-CCT has a header record which contains the supporting agronomic, meteorological, and atmospheric observations.

# FIELD MEASUREMENTS DATA LIBRARY

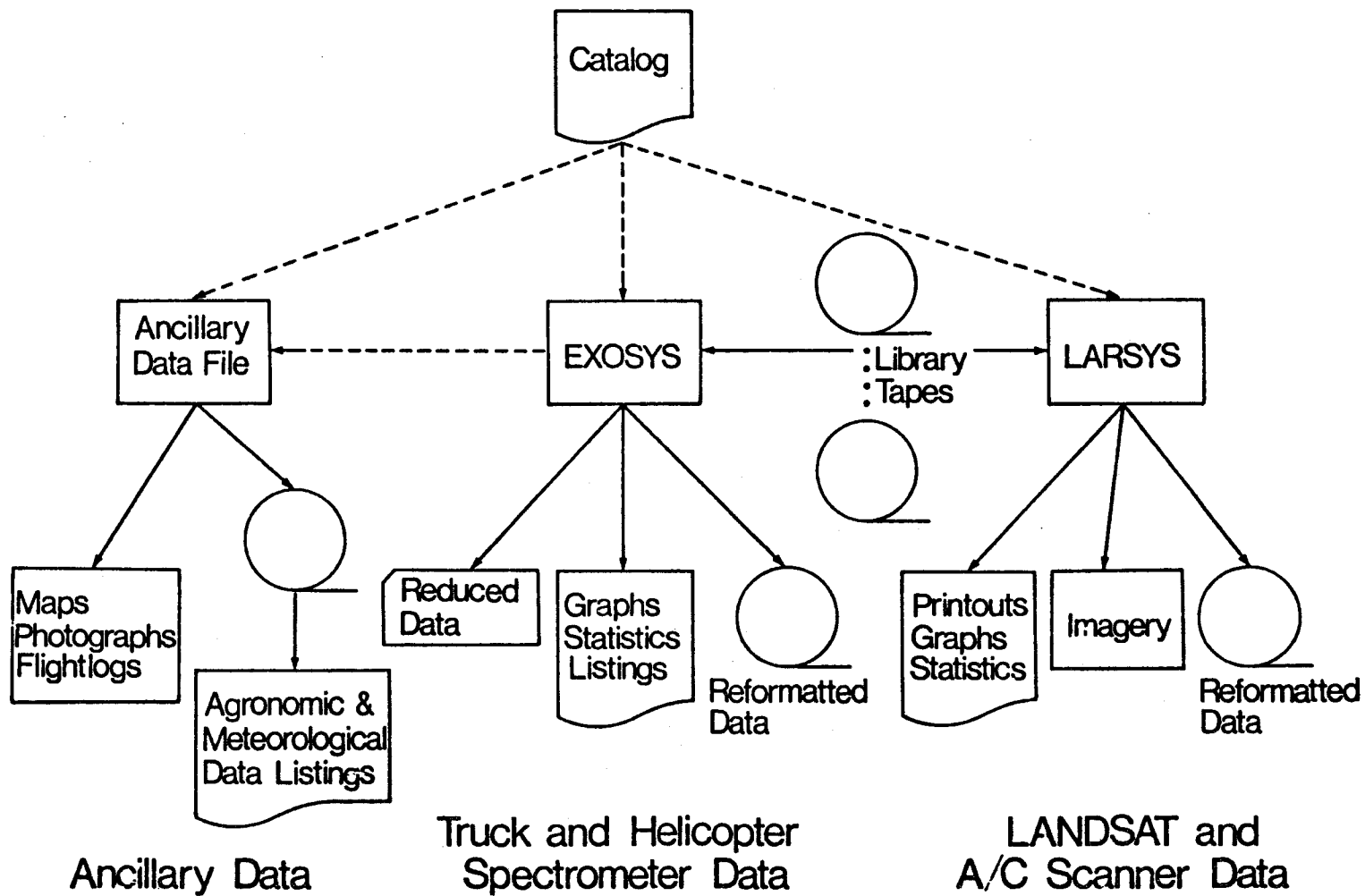


Figure 1-1. Organization of Field Measurements Data Library

## 2. Summary for Field Measurements Data

The Field Measurements Summary includes, for each of the three test sites, mission dates, wheat growth stages, and information concerning which sensor systems collected data (indicated by an X).

The location of the test sites are given in Appendix I.

### 2.1 Summary of remote sensing data collected over the Finney County, Kansas site. (Intensive Test Site-1988, Aircraft Site-076).

#### 1976-77 Crop

Mission	Wheat Growth Stage	Sensor Type					Modeling Data
		Landsat		A/C MSS + MMS	FSS	Truck Mounted	
		1	2				
Sep 9-10	Pre-emergence		X				
Sep 27-30	Pre-emergence			X	X	X	
Oct 13-16	Seedling		X	X	X	X	
Nov 2- 4	Tillering			X	X	X	X
Nov 11-13	Tillering						
Nov 20-21	Tillering		X				
Nov 29-30	Tillering		X				
Mar 8-11	Tillering			X	X	X	
Mar 14	Tillering						
Mar 25-29	Tillering		X			X	X
Apr 1- 2	Tillering						
Apr 13-14	Jointing						X
Apr 19	Jointing						
May 1- 3	Pre-boot		X	X	X	X	X
May 7- 9	Boot	X					
May 19-22	Boot						X
May 27-27	Heading						
Jun 6- 8	Milk					X	X
Jun 12-13	Dough						
Jun 24-26	Ripening		X		X		X
Jun 30	Mature					X	
Jul 12-14	Post Harvest		X	X	X	X	

+ 11 channel modular multispectral scanner



2.2 Summary of remote sensing data collected over the Williams County, North Dakota site. (Intensive Test Site-1966, Aircraft Site-118).

1977 Crop

Mission	Wheat Growth Stage	Sensor Type					Modeling Data
		Landsat		A/C MSS	FSS	Truck Mounted	
		1	2	MMS <sup>+</sup>			
Apr 25	Pre-emergence	X					
May 6- 8	Emergence				X		
May 12	Emergence	X					
May 24-27	Seedling		X		X		
May 30-31	Seedling	X				X	X
Jun 10-13	Tillering						
Jun 17-19	Jointing	X				X	X
Jun 29-Jul 1	Booting		X	X	X	X	X
Jul 5	Heading	X				X	X
Jul 17-19	Dough		X	X	X	X	X
Jul 22-23	Ripening						X
Aug 4-6	Harvest			X	X	X	X
Aug 22-24	Post Harvest			X	X		
Aug 28-29	Post Harvest						
Sep 9	Post Harvest						

<sup>+</sup>11 channel modular multispectral scanner

2.3 Summary of remote sensing data collected over the Hand County,  
South Dakota site. (Intensive Test Site-1687, Aircraft Site-195).

1976-77 Crop

Mission	Growth Stage	Sensor Type			Ground Observations	
		Landsat		A/C MSS + MSS		FSS
		1	2			
Sep 9-10	Pre-emergence		X		X	
Sep 18-24	Pre-emergence	X		X	X	
Sep 27-28	Emergence		X		X	
Oct 6- 7	Emergence				X	
Oct 15-22	Seedling		X	X	X	
Oct 24-25	Seedling					
Nov 2- 3	Tillering		X			
Nov 20-21	Tillering					
Mar 27-Apr 4	Tillering		X			
Apr 14-15	Tillering		X			
Apr 19-22	Tillering			X	X	
May 2	Jointing		X			
May 8-13	Stem Extension			X	X	
May 19-20	Boot		X			
Jun 1- 3	Heading				X	
Jun 7	Heading		X		X	
Jun 13-18	Milk	X		X	X	
Jun 24-25	Dough		X		X	
Jul 1- 9	Ripening	X		X	X	
Jul 12-14	Harvest		X		X	
Jul 18-19	Post Harvest		X			
Jul 26-29	Post Harvest			X	X	
Jul 31	Post Harvest				X	
Aug 16-19	Post Harvest		X		X	

+ 11 channel modular multispectral scanner

### 3. Record of Field Measurements Data

The Field Measurements Data Record is a more detailed listing of the ancillary and major sensor system data collected at the three test sites - Finney County, Kansas; Williams County, North Dakota; and Hand County, South Dakota. The information collected at the Kansas and North Dakota sites is divided into data collection locations - Intensive Test Site, Agriculture Experiment Station, and Canopy Modeling Field. Data is collected only over the intensive test site at the Hand County, South Dakota site.

The record includes mission dates, types of data collected, dates when data were collected, and information indicating whether data is available for users.

3.1.1. Finney County, Kansas Field Measurement Intensive Test Site Data Record  
(Intensive Test Site-1988, Aircraft Site-076).

1976-77 Crop

NC - Not Collected / Indicates data is available from Field Measurements library

Mission	Ancillary Data			Panel Calibration Data	Helicopter	Aircraft	Landsat	Other Data or Comments
	Periodic Ground Observations	Meteorological Optical Depth	Maps					
Sep 9-10	9/10* ✓	9/9 ✓	NC	NC	NC	NC	9/9 ✓	
Sep 27-30	9/28 ✓	9/28 ✓	✓	NC	9/28 ✓	9/28 ✓		
Oct 13-16	10/15 ✓	10/13,15 ✓	✓	10/13 ✓	10/15 ✓	10/13,15 ✓	10/15,16 ✓	No MSS data, film only
Nov 2-4	11/2,3 ✓	11/2,3,4 ✓	✓	NC	11/3 ✓	11/4 ✓		Add'tl Agronomic Meas <sup>+</sup> ✓
Nov 11-13	11/12 ✓	NC	NC	NC	NC	NC		
Nov 20-21	11/20 ✓	NC	NC	NC	NC	NC	11/20 ✓	
Nov 29-30	11/30 ✓	NC	NC	NC	NC	NC		
Mar 8-11	3/8 ✓	3/8 ✓	✓	NC	3/8 ✓	3/8 ✓		
Mar 14	3/14 ✓	NC	NC	NC	NC	NC		
Mar 25-29	3/25 ✓	NC	NC	NC	NC	NC	3/27 ✓	Add'tl Agronomic Meas <sup>+</sup> ✓
Apr 1-2	4/1,2 ✓	NC	NC	NC	NC	NC		
Apr 13-16	4/13,14 ✓	NC	NC	NC	NC	NC		Add'tl Agronomic Meas <sup>+</sup> ✓
Apr 19	4/19 ✓	NC	NC	NC	NC	NC		
May 1-3	5/1 ✓	5/3 ✓	✓	NC	5/3 ✓	5/3 ✓	5/1 ✓	Add'tl Agronomic Meas <sup>+</sup> ✓
May 7-9	5/9 ✓	NC	NC	NC	NC	NC	5/7 ✓	
May 19-22	5/19 ✓	NC	NC	NC	NC	NC		Add'tl Agronomic Meas <sup>+</sup> ✓
May 26-27	5/26,27 ✓	NC	NC	NC	NC	NC		
Jun 6-8	6/6 ✓	NC	NC	NC	NC	NC		Add'tl Agronomic Meas <sup>+</sup> ✓
Jun 12-13	6/12,13 ✓	NC	NC	NC	NC	NC		
Jun 24-26	6/24,25 ✓	6/26 ✓	✓	NC	6/26 ✓	NC	6/24,25 ✓	Add'tl Agronomic Meas <sup>+</sup> ✓
Jun 30	6/30 ✓	NC	NC	NC	NC	NC		
Jul 12-14	7/12 ✓	7/13 ✓	✓	NC	7/13 ✓	7/12 ✓	7/13 ✓	
Sep-Aug								Ground Truth Inventory ✓
Sep-Aug								Rainfall Observations ✓
Jun-Aug								Crop Yield Information ✓

\* Date data were collected

+ Additional agronomic measurements including LAI and Biomass for fields 18, 46, 50, 94, 127, 186, and 214.

3.1.2 Finney County, Kansas: Garden City Agriculture Experiment  
Station Data Record, (Site-G2)

1976-77 Crop

NC - Not Collected    ✓ Indicates data is available from Field Measurements library.

Mission	Ancillary Data				Truck Mounted Spectrometer
	Plot Photos	Plant Meas.	Soil Meas.	Meteorol. Data	
Sep 28-30	9/28* ✓	9/30 ✓	9/30 ✓	9/30 ✓	9/28 ✓
Oct 13-15	10/13,15 ✓	10/14 ✓	10/14 ✓	10/13,14 ✓	10/13,15 ✓
Nov 2- 7	11/3,7 ✓	11/3-5 ✓	11/3-5 ✓	11/3,7 ✓	11/3,7 ✓
Mar 88-14	3/13 ✓	3/9,13 ✓	3/9,13 ✓	3/13 ✓	3/13 ✓
Mar 26-31	3/30 ✓	3/26,27 ✓	3/29 ✓	3/30 ✓	3/30 ✓
Apr 12-18		4/11,12 ✓	4/11 ✓	NC	NC
May 1- 5	5/4,5 ✓	5/2,3,5 ✓	5/4 ✓	5/4,5 ✓	5/4,5 ✓
May 19-25		5/18,20,22 ✓	NC	NC	NC
Jun 4- 9	6/5 ✓	6/4,5 ✓	6/5 ✓	6/5 ✓	6/5 ✓
Jun 24-30	6/30 ✓	6/23-26 ✓	6/23,30 ✓	6/30 ✓	6/30 ✓
Jul 6-10	7/10 ✓	NC	NC	7/10 ✓	7/10 ✓

\* Date data were collected

3.1.3 Finney County, Kansas Field Measurements Canopy Modeling Data Record.  
(Intensive Test Site - 1988, Field No. 46)

1976-1977 Crop

NC - Not Collected    ✓ - Indicates data is available from Field Measurements Library

Mission	Agronomic	Photographic		Spectral	
		Angular	Profile	Reflectance	Transmittance
Nov 3	11/3 ✓	11/3 ✓	NC	11/3 ✓	11/3 ✓
Mar 23-27	3/26 ✓	3/26 ✓	NC	3/23,25✓	3/23 ✓
Apr 15	4/15 ✓	4/15 ✓	NC	NC	NC
May 1	5/1 ✓	5/1 ✓	NC	NC	NC
May 19	5/19 ✓	5/19 ✓	5/19 ✓	NC	NC
Jun 6	6/6 ✓		NC	NC	NC
Jun 25-26	6/25,26✓		NC	6/25,26✓	6/25 ✓

3.2.1 Williams County, North Dakota Field Measurements Intensive Test Site Data Record.  
(Intensive Test Site-1966, Aircraft Site-198).

1977 Crop

NC - Not Collected    ✓ - Indicates Data is Available from Field Measurements Library

Mission	Ancillary				Panel Calibration Data	Helicopter	Aircraft	Landsat	Other Data or Comments
	Periodic Ground Observations	Meteorological Optical Depth	Maps						
Apr 25	4/25* ✓	NC	NC		NC	NC	NC	4/24 ✓	
May 6-8	5/6 ✓	5/8 ✓	✓		NC	5/8 ✓	NC	NC	
May 12	5/12 ✓	NC	NC		NC	NC	NC	5/12 ✓	
May 24-27	5/24 ✓	5/24 ✓	✓		NC	5/24 ✓	NC	5/24 ✓	
May 30-31	5/30-31 ✓	NC	NC		NC	NC	NC	5/30 ✓	
Jun 10-13	6/10 ✓	NC	NC		NC	NC	NC	NC	
Jun 17-19	6/17 ✓	NC	NC		NC	NC	NC	6/17 ✓	
Jun 29-Jul 1	6/29 ✓	6/29, 7/1 ✓	✓		6/29 ✓	6/29 ✓	7/1 ✓	6/29 ✓	
Jul 5	7/5 ✓	NC	NC		NC	NC	NC	7/5 ✓	
Jul 17-19	7/18 ✓	7/17 ✓	✓		7/15,17 ✓	7/17 ✓	7/17 ✓	7/17 ✓	
Jul 22-23	7/22 ✓	NC	NC		NC	NC	NC	NC	
Aug 4-6	8/4-5 ✓	8/4 ✓	✓		8/4 ✓	8/4 ✓	8/4 ✓		
Aug 22-24	8/22 ✓	8/24 ✓	✓		NC	8/24 ✓	8/24 ✓		
Aug 28-29	8/29 ✓	NC	NC		NC	NC	NC		
Sep 9	9/9 ✓	NC	NC		NC	NC	NC		
Apr-Jun	-----								Ground Truth Inventory ✓
Apr-Sep	-----								Rainfall Observations ✓
Jul-Sep	-----								Crop Yield Information ✓

\* Date data were collected

3.2.2 Williams County, North Dakota: Williston Agriculture Experiment  
Station Data Record. (Site-W1)

1977 Crop

NC - Not Collected    ✓ Indicates data is available from Field Measurements library.

Mission	Ancillary Data				Truck Mounted Spectrometer
	Plot Photos	Plant Meas.	Soil Meas.	Meteorol. Data	
May 28-Jun 2	5/31*	✓5/31,6/1 ✓	5/31 ✓	5/31 ✓	5/31 ✓
Jun 10-19	6/18,19	✓6/18,19 ✓	6/19 ✓	6/18,19 ✓	6/18,19 ✓
Jun 27-Jul 4	6/28,7/1,3,4 ✓	6/28,7/2 ✓	6/28,7/2 ✓	6/28,7/1,3-4 ✓	6/28,7/1,3-4 ✓
Jul 13-18	7/13,14	✓7/15 ✓	7/15 ✓	7/13,14 ✓	7/13,14 ✓
Jul 20-24	7/20,22	✓7/20 ✓	7/20 ✓	7/20,22 ✓	7/20,22 ✓
Aug 2- 9	8/5,8	✓8/6 ✓	8/6 ✓	8/5,8 ✓	8/5,8 ✓

\* Date data were collected



3.2.3 Williams County, North Dakota Field Measurements Crop Canopy Modeling Data Record.

1977 Crop

NC - Not Collected      ✓ - Indicates data are available from Field Measurements Library

Mission	Collection Location	Agronomic	Photographic		Exotech 100	
			Anguler	Profile	Reflectance	Transmittance
May 28-Jun 2	Exp. Station Plots	6/1*	6/2 ✓	6/2 ✓	6/1	NC
Jun 15-19	Exp. Station Plots	6/15,18	6/15 ✓	6/15 ✓	6/18	NC
	Commercial Field	NC	6/19 ✓	6/19 ✓	NC	
Jun 23-25	Exp. Station Plots	6/23	6/23 <sup>+</sup> ✓	6/23 <sup>+</sup> ✓	6/23,25	6/25
Jul 2-7	Exp. Station Plots	7/2,5,7	7/6 ✓	7/6 ✓	7/3,4,5,7	7/5
Jul 12-15	Exp. Station Plots	7/15	7/15 ✓	7/15 ✓	7/14	NC
Jul 18-20	Commercial Field	7/18	7/18 ✓	7/18 ✓	7/18	NC
	Exp. Station Plots	7/20	NC	NC	7/20	NC
Jul 27-29	Exp. Station Plots	7/28	7/29 ✓	7/29 ✓	7/28	7/28
Aug 5-8	Exp. Station Plots	8/6	NC	NC	8/5,6	NC

\* Date data were collected

+ Photography is of poor quality

3.3 Hand County, South Dakota Field Measurement Intensive Test Site Data Record  
(Intensive Test Site-1687, Aircraft Site-195)  
1976-77 Crop

NC - Not Collected    ✓ Indicates Data is Available from Field Measurements Library

Mission	Ancillary Data			Helicopter	Aircraft	Landsat	Other Data or Comments	
	Periodic Ground Observations	Meteorological Optical Depth	Maps					
Sep 9-10	9/9-10* ✓	9/10 ✓	NC	NC	NC	9/9,10 ✓		
Sep 18-24	9/21 ✓	9/20,21 ✓	✓	9/21 ✓	9/20 ✓	9/18 ✓	Add'tl Agronomic Meas <sup>+</sup> ✓	
Sep 27-28	9/28 ✓	9/28 ✓	NC	NC	NC	9/27,28 ✓		
Oct 6-7	10/6 ✓	10/07 ✓	NC	NC	NC			
Oct 15-22	10/16 ✓	10/16,21 ✓	✓	10/21 ✓	10/21 ✓	10/15,16 ✓	Add'tl Agronomic Meas <sup>+</sup> ✓	
Oct 24-25	10/25 ✓	10/25 ✓	NC	NC	NC			
Nov 2-3	11/3 ✓	NC	NC	NC	NC	11/2 ✓		
Nov 20-21	11/20 ✓	NC	NC	NC	NC			
Mar 27-Apr 4	4/2-4 ✓	NC	NC	NC	NC	3/27 ✓		
Apr 14-15	4/14,15 ✓	NC	NC	NC	NC	4/13,14 ✓		
Apr 19-22	4/21,22 ✓	4/21 ✓	✓	4/21 ✓	4/21 ✓		Add'tl Agronomic Meas <sup>+</sup> ✓	
May 2	5/2 ✓	NC	NC	NC	NC	5/2 ✓		
May 8-13	5/10,11 ✓	5/10 ✓	✓	5/10 ✓	5/10 ✓		Add'tl Agronomic Meas <sup>+</sup> ✓	
May 19-20	5/19 ✓	NC	NC	NC	NC	5/19,20 ✓		
Jun 1-3	6/1 ✓	6/1 ✓	✓	6/1 ✓	NC		Add'tl Agronomic Meas <sup>+</sup> ✓	
Jun 7	6/7 ✓	NC	NC	NC	NC	6/7 ✓	Add'tl Agronomic Meas <sup>+</sup> ✓	
Jun 13-18	6/16 ✓	6/16 ✓	✓	6/16 ✓	6/16 ✓	6/13 ✓	No MSS data, film only	
Jun 24-25	6/24-25 ✓	NC	NC	NC	NC	6/24,25 ✓		
Jul 1-9	7/7 ✓	7/7 ✓	✓	7/7 ✓	7/7 ✓	6/30,7/1 ✓	Add'tl Agronomic Meas <sup>+</sup> ✓	
Jul 12-14	7/12-14 ✓	NC	NC	NC	NC	7/12,13 ✓		
Jul 18-19	NC	NC	NC	NC	NC	7/18,19 ✓		
Jul 26-29	7/27 ✓	7/27 ✓	✓	7/27 ✓	7/27 ✓		Add'tl Agronomic Meas <sup>+</sup> ✓	
Jul 31	7/31 ✓	NC	NC	NC	NC	NC		
Aug 16-19	8/18-19 ✓	NC	NC	NC	NC	8/17,18 ✓		
Sep-Aug							Ground Truth Inventory	✓
Sep-Aug							Rainfall Observations	✓
Jul-Aug							Crop Yield Information	✓

\* Date data were collected

+ Additional agronomic measurements including LAI and Biomass for fields 108, 171, 176, 177, 178, 188, 198, 199, 201, 211, 212, and 235.

#### 4. Index of Field Measurements Data

The Field Measurements Data Index includes a section for each of the major sensor systems which collect LACIE Field Measurements data - Landsat, Aircraft Multispectral Scanner, Field Spectrometer System (FSS) or S191-H, Field Spectrometer Acquisition System (FSAS), Exotech Model 20C and Exotech Model 100. Refer to Appendix IV for a summary of the LACIE Field Measurements Sensor data specifications and operational characteristics.

##### 4.1 Landsat Data Library Index

The Landsat I and II multispectral scanners collect data in four spectral bands - 0.5 to 0.6 $\mu$ m, 0.6 to 0.7 $\mu$ m, 0.7 to 0.8 $\mu$ m, and 0.8 to 1.1 $\mu$ m. The Landsat data include:

- o 9-track computer-compatible tapes (CCT's)
- o Black-and-white transparencies of each band
- o Color-composite transparency

The Landsat Data Index includes, for each of the three sites, the date data were collected, the scene ID, the cloud cover over the respective intensive test site, the cloud cover over the entire frame, and the LARSYS formatted computer compatible tape (CCT) run number. Also noted under the "Test Site Cloud Cover" are those scene ID's which do not include the entire test site. The last column indicates (with an X) whether Landsat imagery is in the Field Measurements Data Library.

4.1.1 Landsat Data Library Index for the Finney County, Kansas Test Site.  
(Intensive Test Site-1988).

<u>Collected</u>	<u>Scene ID</u>	<u>Test Site*</u> <u>Cloud</u> <u>Cover</u>	<u>Frame*</u> <u>Cloud</u> <u>Cover</u>	<u>LARS</u> <u>Run</u> <u>Number</u>	<u>Imagery</u>
9/09/76	2596-16312	0	60	76007600	X
9/18/76	5518-15583	70	50	76007800	X
10/06/76	5536-15571	100	70	NR	X
10/15/76	2632-16295	0	5	76010900	X
10/16/76	2633-16353	50h	10	NR	X
11/20/76	2668-16285	0	5	76011800	X
3/27/77	2795-16285	0	3	77001900	X
5/01/77	2830-16214	3	20	77002300	X
5/07/77	5749-15381 <sup>a</sup>	0	0	77002200	X
6/25/77	2885-16242	100	60	NR	X
7/06/77	2866-16195	100	90	NR	X
7/13/77	2903-16232	0	2	77001500	X
7/18/77	5821-15310 <sup>a</sup>	0	2	77001300	X

\* - Percent

h - Haze overcast

NR - Not reformatted; cloud cover too extensive

a - Only channels 2,3,4 are available

4.1.2 Landsat Data Library Index for the Williams County, North Dakota Test Site. (Intensive Test Site-1966).

<u>Collected</u>	<u>Scene ID</u>	<u>Test Site*</u> <u>Cloud</u> <u>Cover</u>	<u>Frame*</u> <u>Cloud</u> <u>Cover</u>	<u>LARS</u> <u>Run</u> <u>Number</u>	<u>Imagery</u>
4/18/77	2817-16475	15(100h)	20	NR	X
4/24/77	5736-16044 <sup>a</sup>	0	0	77002600	X
5/12/77	5754-16030 <sup>a</sup>	50h	2h	77007100	X
5/24/77	2853-16455	0	35	77001600	X
5/30/77	5772-16012 <sup>a</sup>	100	50	NR	X
6/17/77	5790-15593 <sup>a</sup>	50	40	NR	X
6/29/77	2889-16440	90	60	NR	X
7/05/77	5808-15574 <sup>a</sup>	70	50	NR	X
7/17/77	2907-16431	0	10	77002400	X

\* - Percent

a - Only channels 2,3,4 are available

h - haze overcast

NR - Not reformatted; cloud cover too extensive

4.1.3 Landsat Data Library Index for the Hand County, South Dakota Test Site. (Intensive Test Site - 1687).

<u>Collected</u>	<u>Scene ID</u>	<u>Test Site* Cloud Cover</u>	<u>Frame* Cloud Cover</u>	<u>LARS Run Number</u>	<u>Imagery</u>
9/01/76	5501-16034	0	20	76007000	X
9/09/76	2596-16291	0(90)+	5	76007500	X
9/10/76	2597-16350	0	0	76007400	X
9/18/76	5518-15563	100	50	76007700	X
9/27/76	2614-16284	10	50	76008600	X
9/28/76	2615-16342	0	0	76001300	X
10/15/76	2632-16281			76008600	
10/16/76	2633-16335	5	15	76008800	X
11/02/76	2650-16273	70	40	NR	X
3/08/77	2776-16222	100s	100s	NR	X
3/09/77	2777-16281	100s	50 50s	NR	X
3/27/77	2795-16271	0	3	77001800	X
4/13/77	2812-16204	0	5	77001200	X
4/14/77	2813-16262	0	80	77002000	X
5/02/77	2831-16252	40	50	NR	X
5/19/77	2848-16184	3	30	77001700	X
5/20/77	2849-16242	60h	10	NR	X
5/25/77	5767-15342 <sup>a</sup>	0	2h	77002100	X
5/26/77	5768-15400 <sup>a</sup>	30	50	NR	X
6/07/77	2867-16233	0	0	77002800	X
6/13/77	5786-15382 <sup>a</sup>	10	70	77002500	X
6/24/77	2884-16165	100	65	NR	X
6/25/77	2885-16224	50	30	NR	X
6/30/77	5803-15305	50	20	NR	X
7/01/77	5804-15363 <sup>a</sup>	0	0	77001400	X
7/12/77	2902-16160	0	0	77001100	X
7/13/77	2903-16214	0	10	77001000	X
7/18/77	5821-15290 <sup>a</sup>	0	0	77002700	X
7/19/77	5822-15343 <sup>a</sup>	100	65	NR	X
8/17/77	2938-16140	0	1	77002900	X
8/18/77	2939-16195	0	10		X

\* - Percent

+ - Percent of site included

NR - Not reformatted; cloud cover too extensive

a - Only channels 2,3,4 are available

s - snow covered

h - haze overcast

## 4.2 Aircraft Data Library Index

The NASA P-3 aircraft with the 11-channel modular multispectral scanner (MMS) collected data for the LACIE Field Measurements project during the 1976-77 crop year. The spectral bands of the scanner are given in Table 4.2-1.

Table 4.2-1 Spectral Bands of MMS Scanner

MSS (in $\mu\text{m}.$ )
0.38- 0.41
0.44- 0.49
0.49- 0.53
0.54- 0.58
0.58- 0.62
0.62- 0.66
0.66- 0.70
0.70- 0.74
0.76- 0.86
0.97- 1.06
8.00-13.00

Aircraft data include:

- 9-track CCTs (proportional to scene radiance)
- 9-inch color-infrared photographs
- 70-millimeter, six-band airborne multispectral photographic system photographs obtained over Hand County only
- Flight logs
- Photo logs

The index includes, for each of the sites, the scanner system used, the date, the flight lines flown, the start times for the flight lines, the altitude flown and the LARS run numbers for the respective LARSYS formatted scanner data. Also, included in the last column are the NASA/JSC mission and roll film numbers for the 9 in. color IR (CI) underflight photography.

4.2.1 Aircraft Data Library Index for Finney County, Kansas Test Site.  
(Intensive Test Site - 1988, Aircraft Site - 076).

<u>Mission Date</u>	<u>Flight Line</u>	<u>Start Time(GMT)</u>	<u>Altitude AGL(meters)</u>	<u>LARS Scanner Data Run Number</u>	<u>JSC Mission and Roll Film Numbers</u>
9/28/76 ↓	9	15:03:25	6860	760120	MX 344
	10	15:16:10	3050	760121	CR-10
	9	15:21:40	3050	760122	CI-11
	8	15:26:55	3050	760123	↓
10/13/76 ↓	9	16:07:50	6980	<del>760193</del>	MX 348
	9	16:19:00	3050	760194	CI-3
	10	16:22:45	3050	760195	↓
	8	16:28:20	3050	760196	↓
	12	16:37:30	460	760197	↓
	11	16:43:20	460	760198	↓
11/04/76 ↓	8	16:45:00	3050	760177	MX 348
	9	16:52:12	3110	760178	CI-18
	10	16:58:30	3080	760179	↓
	11	17:07:52	460	760180	↓
	9	17:34:50	6890	760181	↓
3/08/77 ↓	9	16:18:55	6890	770001	MX 354
	8	16:30:45	3050	770002	CI-3
	9	16:37:45	3080	770003	↓
	10	16:44:42	3050	770004	↓
	12	16:54:19	460	770005	↓
	11	17:00:00	460	770006	↓
5/03/77 ↓	9	15:38:40	7010	770066	MX 359
	8	15:51:20	2960	*	CI-1
	9	15:58:00	2930	*	↓
	10	16:05:20	2960	*	↓
	8	16:13:10	2930	*	↓
	12	16:23:40	430	770068	↓
	11	16:37:45	490	770067	↓
7/12/77 ↓	9	18:54:20	7530	770055	MX 365
	9	19:05:35	3200	770056	CI-10
	10	19:12:15	3020	770057	↓
	8	19:18:30	3050	770058	↓
	12	19:26:00	460	770060	↓
	11	19:32:20	460	770059	↓

\* Not processed, too many clouds in field of view



4.2.2 Aircraft Data Library Index for Williams County, North Dakota Test Site. (Intensive Test Site - 1966, Aircraft Site - 118).

<u>Mission Date</u>	<u>Flight Line</u>	<u>Start Time(GMT)</u>	<u>Altitude AGL(meters)</u>	<u>LARS Scanner Data Run Number</u>	<u>JSC Mission and Roll Film Numbers</u>
7/01/77	6	15:20:35	460	770053	MX361
	7	15:29:00	460	770054	CI-11
	3	15:40:50	2990	770052	
	2	15:46:15	3140	770050	
	1	15:52:00	2990	770049	
	2	16:12:00	7190	770051	
7/17/77	2	16:08:40	7350	770044	MX 365
	3	16:19:10	3200	770045	CI-13
	2	16:24:55	3170	770045	
	1	16:31:30	3110	770043	
	6	16:45:30	430	770047	
	7	16:53:25	460	770048	
8/04/77	2	15:41:30	7100	770078	MX 366
	1	15:51:55	3080	770079	CI-10
	2	15:58:50	3050	770080	
	3	16:12:30	3050	770081	
	6	16:23:15	460	770082	
	7	16:32:05	520	770083	
8/24/77	2	18:44:10	7320	770084	MX 367
	1	18:56:55	3110	770085	CI-2
	2	19:03:45	3050	770086	
	3	19:11:35	2990	770087	
	6	19:22:10	460	770088	
	7	19:31:45	370	*	
	7	19:36:05	460	770089	

\* Not processed

4.2.3 Aircraft Data Library Index for Hand County, South Dakota Test Site.  
(Intensive Test Site - 1687, Aircraft Site - 195).

<u>Mission Date</u>	<u>Flight Line</u>	<u>Start Time(GMT)</u>	<u>Altitude AGL(meters)</u>	<u>LARS Scanner Data Run Number</u>	<u>JSC Mission and Roll Film Numbers</u>
9/20/76 ↓	2	18:04:45	7410	760144	MX 344
	1	18:15:15	3080	760145	CR-2
	2	18:22:36	3110	700146	CI-3
	3	18:28:00	3080	700147	↓
	5	18:36:30	460	760148	
	4	18:47:00	460	760149	↓
10/21/76 ↓	1	16:34:45	3200	760171	MX 348
	2	16:42:40	3200	760172	CI-4
	5	17:04:25	3230	760173	↓
	4	17:16:30	460	760174	
	2	17:40:10	7100	760175	↓
4/21/77 ↓	2	16:31:45	7320	770038	MX 357
	1	16:45:40	3050	770037	CI-2
	2	16:53:00	3050	770039	↓
	3	17:00:50	3050	770040	
	5	17:09:25	460	770042	
	4	17:18:25	460	770041	↓
5/10/77 ↓	2	17:02:30	7160	+	MX 359
	1	17:18:05	3050	770007	CI-4
	2	17:26:30	3050	+	↓
	3	17:34:30	3050	+	
	5	17:43:25	460	770008	
	4	17:54:50	460	770009	↓
6/16/77 ↓	2	17:41:10	7470	*	MX 361
	1	18:01:40	3050	*	CI-2
	2	18:06:55	3050	*	↓
	2	18:12:25	3050	*	
	5	18:21:25	370	*	
	5	18:32:25	460	*	
	4	18:43:30	460	*	↓
7/07/77 ↓	2	16:43:05	7530	770062	MX 365
	3	16:58:20	3050	770064	CI-1
	2	17:04:45	2990	*	↓
	1	17:10:30	3050	*	
	4	17:23:50	460	*	
	5	17:44:50	460	770065	
	3	18:29:50	2770	*	
	2	18:38:50	2770	770063	
	1	18:44:30	2900	770061	
	5	18:54:40	460	*	↓

Aircraft Data Library Index for Hand County, South Dakota Test Site.  
(Intensive Test Site - 1687, Aircraft Site - 195). (cont.)

<u>Mission Date</u>	<u>Flight Line</u>	<u>Start Time(GMT)</u>	<u>Altitude AGL(meters)</u>	<u>LARS Scanner Data Run Number</u>	<u>JSC Mission and Roll Film Numbers</u>
7/27/77	2	19:55:30	7800	770072	MX 366
↓	2	20:10:15	3100	770073	CI-3
	3	20:17:00	3140	770074	↓
	1	20:22:50	3110	770075	
	5	20:32:10	460	770076	
	4	20:42:50	460	770077	

+ Lines were missed

\* Not processed, too many clouds in field of view

#### 4.3 Field Spectrometer System (FSS) S191-H Data Library Index

The Field Spectrometer System (FSS) or S191-H system collected two types of data in general, spectral data and 70mm color photography, over the flight lines. The FSS spectral data consists of .02  $\mu\text{m}$  wide bands from 0.4 to 1.1  $\mu\text{m}$ , .05  $\mu\text{m}$  wide bands from 1.1 to 2.4  $\mu\text{m}$ , and 0.5  $\mu\text{m}$  wide bands from 8.0 to 14.0  $\mu\text{m}$ . The spectral data collected over the test site are processed in two different formats. One format includes all individual observations collected over each field (single scan data) and one format includes only the average of all similar scans within each field (field average data). The FSS data include:

- ° 9-track CCTs (bidirectional reflectance factor)
  - single scan data
  - field average data
- ° Microfilm tabulation of data on CCTs
- ° 70-millimeter boresight color photographs
- ° Flight logs
- ° Supporting agronomic, meteorological, and atmospheric observations

The index for the FSS data includes the mission date, flight line start time (GMT) for the flight line, and helicopter data flight number. The Index also includes the JSC 70mm color photography roll identification - mission and roll film numbers.

4.3.1 FSS(S191H) Data Library Index for the Finney County, Kansas  
Test Site. (Intensive Test Site - 1988, Aircraft Site - 076).

<u>Mission Date</u>	<u>Flight Line</u>	<u>Start Time(GMT)</u>	<u>Data Flight</u>	<u>JSC Roll Film ID (Mission, Roll #)</u>
9/28/76 ↓	8	16:22:28	55 ↓	H-18, 192
	9	16:44:05		193
	10	17:06:20		194
10/15/76 ↓	8	16:05:38	56A ↓	H-18, 198
	9	17:44:10		199
	10	18:04:50		200
11/03/76 ↓	8	17:33:53	58 ↓	H-18, 205
	9	17:54:44		206
	10	18:20:22		207
3/08/77 ↓	8	16:07:13	59 ↓	H-22, 208
	9	16:30:08		209
	10	16:54:28		210
5/03/77 ↓	8	15:16:35	63 ↓	H-22, 215
	9	15:36:42		216
	10	15:57:22		217
6/26/77 ↓	8	15:00:35	72 ↓	H-22, 236
	9	15:22:57		237
	10	15:44:14		238
7/13/77 ↓	8	15:06:00	75 ↓	H-22, 245
	9	15:25:30		246
	10	15:48:00		247

4.3.2 FSS(S191H) Data Library Index for the Williams County, North Dakota Test Site. (Intensive Test Site - 1966, Aircraft Site - 118).

<u>Mission Date</u>	<u>Flight Line</u>	<u>Start Time(GMT)</u>	<u>Data Flight</u>	<u>JSC Roll Film ID (Mission, Roll #)</u>
5/08/77	1	18:08:21	64	H-22, 218
	2	18:28:36		219
	3	19:17:49		220
5/24/77	1	16:36:20	67	H-22, 225
	2	17:07:06		226
	3	17:29:24		227
6/29/77	1	17:52:04	73	H-22, 239
	2	18:11:20		240
	3	21:20:50		241
7/17/77	1	15:09:33	76	H-22, 248
	2	15:28:47		249
	3	15:47:26		250
	New Panel 1*	16:02:50		
	Panel 2*	16:08:10		
	Panel 5*	16:12:45		
	Panel 3*	16:16:40		
	Panel 4*	16:22:05		
8/04/77	1	16:54:42	78	H-22, 256
	3	17:16:18		257
	2	17:43:39		258
	Green Panel*	19:15:35		
8/24/77	1	18:54:05	80	H-22, 259
	2	19:16:23		260
	3	19:37:25		261

\* Spectrometer Intercomparison Data

4.3.3 FSS(S191H) Data Library Index for the Hand County, South Dakota Test Site. (Intensive Test Site - 1687, Aircraft Site - 195).

<u>Mission Date</u>	<u>Flight Line</u>	<u>Start Time(GMT)</u>	<u>Data Flight</u>	<u>JSC Roll Film ID (Mission, Roll #)</u>
9/21/76 ↓	1	18:19:50	54 ↓	H-18, 188
	2	18:43:24		189
	3	19:04:11		190
	4	19:35:20		191
10/21/76 ↓	1	16:39:38	57 ↓	H-18, 201
	2	17:05:19		202
	3	17:27:50		203
	4	17:59:00		204
4/21/77 ↓	1	15:47:44	62 ↓	H-22, 211
	2	16:10:30		212
	3	16:35:50		213
	4	17:18:40		214
5/10/77 ↓	1	18:00:49	65 ↓	H-22, 221
	2	18:20:35		222
	3	18:41:22		223
	4	19:19:31		224
6/01/77 ↓	2	14:49:27	68 ↓	H-22, 228
	1	15:09:40		229
	3	15:29:57		230
	4	16:01:09		231
6/16/77 ↓	1	15:50:57	71 ↓	H-22, 232
	2	16:09:45		233
	3	16:29:50		234
	4	17:02:45		235
7/07/77 ↓	1	16:45:55	74 ↓	H-22, 242
	3	18:49:45		243
7/27/77 ↓	1	17:19:36	77 ↓	H-22, 252
	3	19:50:04		253
	2	20:15:50		254
	4	20:46:08		255

## 4.4 FSAS Data Library Index

The NASA/JSC truck-mounted interferometer system, the Field Signature Acquisition System (FSAS), acquired spectral data in the range of 0.4 to 2.4  $\mu\text{m}$ . The data were processed into .01  $\mu\text{m}$  bands. The FSAS data include:

- 9-track CCT's (bidirectional reflectance factor)
- 35-millimeter color transparencies (vertical and oblique)
- Supporting agronomic, meteorological, and atmospheric observations

The index for the FSAS data includes the location where the data were collected, the mission data, the experiment for which data were collected, and the number of observations collected.

## Location Legend:

AES(G2) - Garden City Agriculture Experiment Station, Site-G2  
 ITS(1988) - Calibration Panel Location at Intensive Test Site-1988  
 ITS(1966) - Calibration Panel Location at Intensive Test Site-1966

## Finney County, Kansas

<u>Location</u>	<u>Mission Date</u>	<u>Experiment Name</u>	<u>Number of Observations</u>
AES(G2)	9/30/76	Other Crop	2
ITS(1988)	10/13/76	Calibration Panels	9
AES(G2)	↓	Dryland Winter Wheat	1
↓	10/14/76	Small Grains	28
	↓	Dryland Winter Wheat	12
	↓	Irrigated Winter Wheat	12
	11/03/76	Dryland Winter Wheat	13
	11/07/76	Small Grains	28
↓	↓	Dryland Winter Wheat	3
		Irrigated Winter Wheat	8



## FSAS Data Library Index (cont'd)

<u>Location</u>	<u>Mission Date</u>	<u>Experiment Name</u>	<u>Number of Observations</u>
AES(G2)	3/13/77	Small Grains	29
	↓	Dryland Winter Wheat	15
	↓	Irrigated Winter Wheat	15
	3/30/77	Small Grains	9
	↓	Dryland Winter Wheat	16
	5/04/77	Small Grains	17
	↓	Dryland Winter Wheat	16
	↓	Irrigated Winter Wheat	8
	↓	Other Crops	2
	5/05/77	Small Grains	9
	6/05/77	Small Grains	17
	↓	Dryland Winter Wheat	13
	6/30/77	Small Grains	17
	↓	Dryland Winter Wheat	16
↓	Irrigated Winter Wheat	9	
↓	Other Crops	3	
7/10/77	Small Grains	26	
↓	Dryland Winter Wheat	13	
↓	Irrigated Winter Wheat	16	
↓	Other Crops	3	
Williams County, North Dakota			
ITS(1966)	7/15/77	Intercomparison	
	↓	Panel 1	8
		4x4 PNL-1	9
		Panel 2	6
		Panel 3	3
		Panel 4	3
		Panel 5	3
		Green Panel	3
	7/17/77	Intercomparison	
	↓	Spring Wheat	3
	↓	Panel 1 New	2
	↓	Drape Test	1

## 4.5 Exotech Model 20C Data Library Index

The Purdue/LARS truck-mounted system, an Exotech Model 20C circular variable filterwheel spectrometer, acquired spectral data in the range of 0.4 to 2.4 $\mu$ m and in certain situations from 2.8 to 13.4 $\mu$ m. The reflective data is processed into .01 $\mu$ m wide bands and the thermal data is processed into .05 $\mu$ m wide bands. The Exotech 20C data include:

- . 9-track CCT's (bidirectional reflectance factor)
- . 35-millimeter color prints (vertical and obliques)
- . Supporting agronomic and meteorological observations

The index for the Exotech 20C data includes the location where the data were collected, the mission date, the experiment for which the data were collected, and the number of observations collected.

## Location Legend

- AES(W1) - Williston Agriculture Experiment Station, Site - W1  
 ITS(1966) - Calibration Panel Location at Intensive Test Site - 1966  
 ITS(1988) - Calibration Panel Location at Intensive Test Site - 1988

## Finney County, Kansas

<u>Location</u>	<u>Mission Date</u>	<u>Experiment Name</u>	<u>Number of Observations</u>
ITS(1988)	5/22/77	Calibration*	10
	5/23/77	Calibration*	22
	5/24/77	Calibration*	6

## Williams County, North Dakota

<u>Location</u>	<u>Mission Date</u>	<u>Experiment Name</u>	<u>Number of Observations</u>
AES(W1) ↓	5/31/77 ↓	Spring Wheat	38
		Small Grain	34
		Other Crops	7
		Calibration	17
	6/18/77 ↓	Spring Wheat	40
		Small Grain	6
		Other Crops	7
		Calibration	11

## Exotech Model 20C Data Library Index (cont'd)

<u>Location</u>	<u>Mission Date</u>	<u>Experiment Name</u>	<u>Number of Observations</u>
AES(W1)	6/19/77	Small Grain	14
		Other Crops	1
		Calibration	2
ITS(1966)	6/28/77	Small Grain	32
		Other Crops	2
		Calibration	7
AES(W1)	7/01/77	Spring Wheat	41
		Small Grain	41
		Other Crops	8
		Calibration	18
	7/03/77	Spring Wheat	18
		Other Crops	1
		Calibration	5
	7/04/77	Spring Wheat	16
		Small Grain	2
		Other Crops	4
		Calibration	5
	7/13/77	Spring Wheat	37
Other Crops		9	
Calibration		9	
7/14/77	Spring Wheat	43	
	Small Grain	36	
	Other Crops	9	
	Calibration	19	
ITS(1966)	7/15/77	Calibration*	43
AES(W1)	7/17/77	Calibration*	25
AES(W1)	7/20/77	Spring Wheat	38
		Other Crops	3
		Calibration	11
7/22/77	Small Grain	50	
	Other Crops	1	
	Calibration	14	
ITS(1966)	8/04/77	Calibration*	18
AES(W1)	8/05/77	Spring Wheat	44
		Small Grain	33
		Other Crops	3
		Calibration	27
8/08/77	Spring Wheat	36	
	Calibration	6	

\*Spectrometer Intercomparison Data

Appendix I

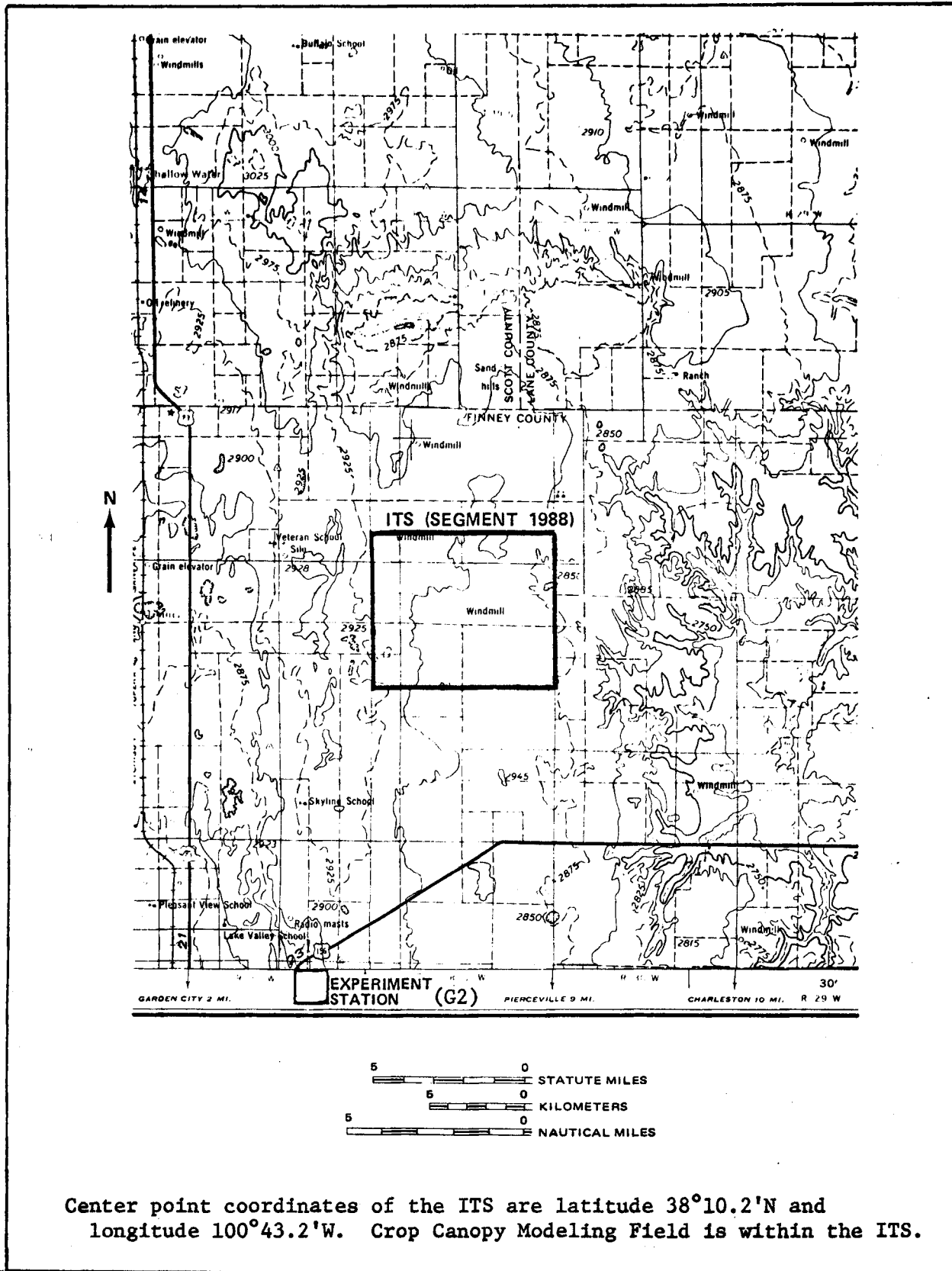
Location of LACIE Field Measurements Test Sites  
and Flight Lines

Location of the Three Test Sites

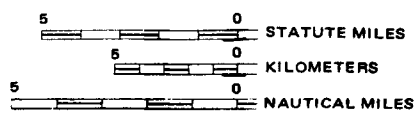
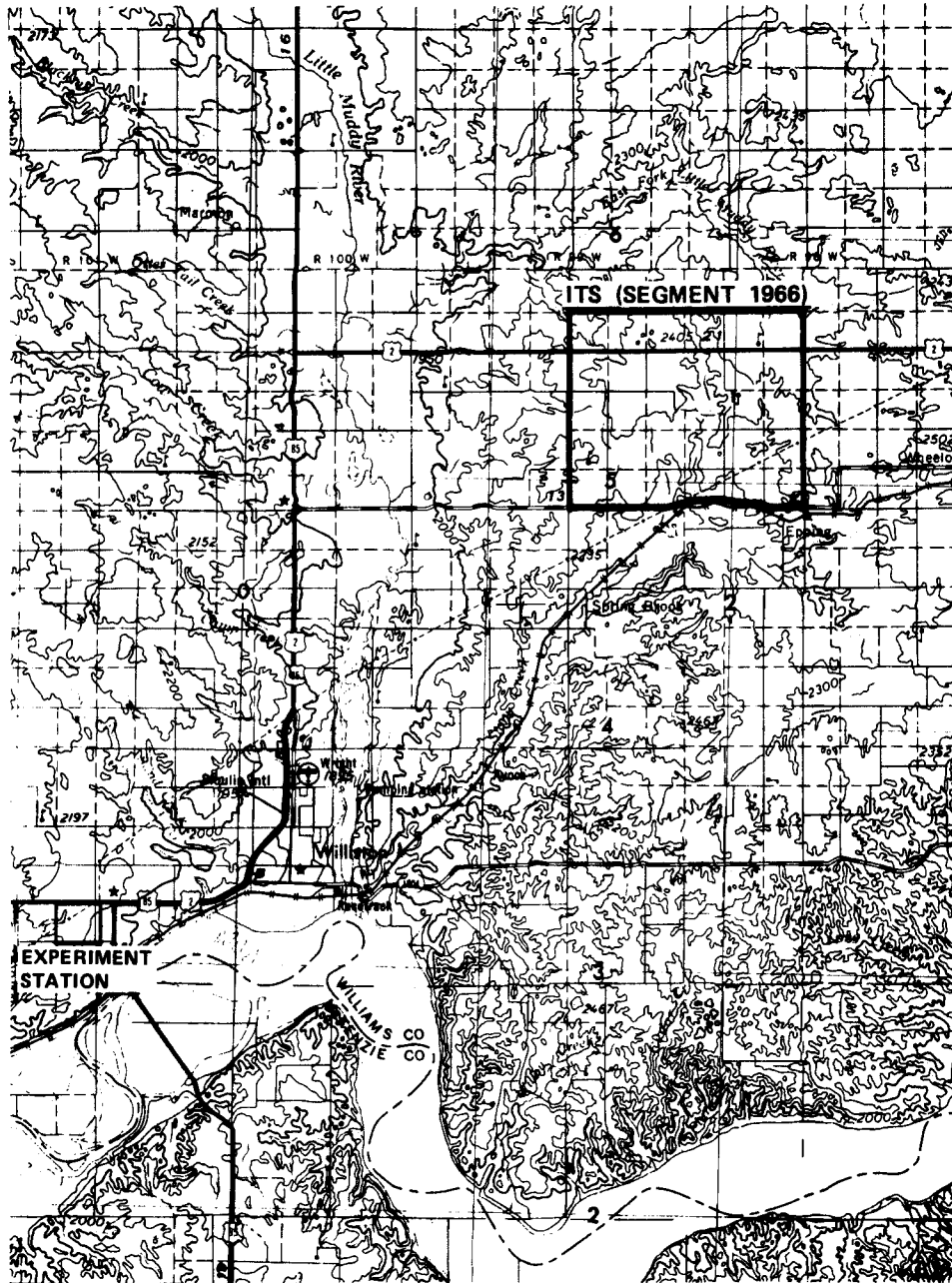


LEGEND	
1	FINNEY COUNTY, KANSAS
2	HAND COUNTY, SOUTH DAKOTA
3	WILLIAMS COUNTY, NORTH DAKOTA

Finney County, Kansas, Data Collection Locations  
 During the 1976-77 Crop Year



Williams County, North Dakota, Data Collection Locations  
During the 1977 Crop Year



Center point coordinates of the ITS are latitude 48°19.02' N. and longitude 103°24.52' W.







1977 Williston, North Dakota Agriculture Experiment Station

Remote Sensing Experiments (Site-W1)

SPRING WHEAT EXPERIMENT

Plot No.	Rep 2																Rep 1								Rep 2																Rep 1								1
	35	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1														
	Winter Wheat	N <sub>2</sub>	N <sub>2</sub>	N <sub>1</sub>	N <sub>1</sub>	N <sub>1</sub>	N <sub>1</sub>	N <sub>2</sub>	N <sub>2</sub>	N <sub>2</sub>	N <sub>2</sub>	N <sub>1</sub>	N <sub>1</sub>	N <sub>2</sub>	N <sub>2</sub>	N <sub>1</sub>	N <sub>1</sub>	N <sub>1</sub>	N <sub>1</sub>	N <sub>2</sub>	N <sub>2</sub>	N <sub>2</sub>	N <sub>1</sub>	N <sub>1</sub>	N <sub>1</sub>	N <sub>1</sub>	N <sub>2</sub>	N <sub>2</sub>	N <sub>1</sub>	N <sub>1</sub>	N <sub>2</sub>	N <sub>2</sub>	N <sub>1</sub>	N <sub>1</sub>	N <sub>2</sub>	N <sub>2</sub>	Bare Soil	Winter Wheat											
		V <sub>1</sub>	V <sub>1</sub>	V <sub>2</sub>	V <sub>2</sub>	V <sub>1</sub>	V <sub>1</sub>	V <sub>2</sub>	V <sub>2</sub>	V <sub>1</sub>	V <sub>2</sub>	V <sub>2</sub>	V <sub>1</sub>	V <sub>1</sub>	V <sub>2</sub>	V <sub>1</sub>	V <sub>2</sub>	V <sub>1</sub>	V <sub>2</sub>	V <sub>2</sub>	V <sub>1</sub>	V <sub>2</sub>	V <sub>2</sub>	V <sub>1</sub>	V <sub>1</sub>	V <sub>2</sub>	V <sub>1</sub>	V <sub>2</sub>	V <sub>2</sub>	V <sub>1</sub>	V <sub>1</sub>	V <sub>2</sub>	V <sub>2</sub>	V <sub>1</sub>	V <sub>1</sub>	Bare Soil	Winter Wheat												
		D <sub>2</sub>	D <sub>1</sub>	D <sub>2</sub>	D <sub>1</sub>	D <sub>1</sub>	D <sub>2</sub>	D <sub>1</sub>	D <sub>2</sub>	D <sub>2</sub>	D <sub>2</sub>	D <sub>1</sub>	D <sub>1</sub>	D <sub>1</sub>	D <sub>1</sub>	D <sub>2</sub>	D <sub>2</sub>	D <sub>1</sub>	D <sub>2</sub>	D <sub>2</sub>	D <sub>1</sub>	D <sub>2</sub>	D <sub>2</sub>	D <sub>1</sub>	D <sub>2</sub>	D <sub>2</sub>	D <sub>2</sub>	D <sub>1</sub>	D <sub>1</sub>	D <sub>1</sub>	D <sub>1</sub>	D <sub>2</sub>	D <sub>2</sub>	Bare Soil	Winter Wheat														

Fallow in 1976

Wheat in 1976

Nitrogen

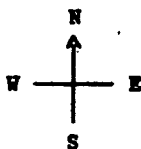
Variety

Planting Date

N<sub>1</sub> = 0 kg N/ha  
N<sub>2</sub> = 44 kg N/ha

V<sub>1</sub> = Waldron (awnless)  
V<sub>2</sub> = Olaf (awned)

D<sub>1</sub> = May 9, 1977  
D<sub>2</sub> = May 23, 1977



SMALL GRAINS EXPERIMENT

Plot No.	Rep 2																Rep 1								Rep 2																Rep 1								36			
	70	69	68	67	66	65	64	63	62	61	60	59	58	57	56	55	54	53	52	51	50	49	48	47	46	45	44	43	42	41	40	39	38	37	36																	
	Winter Wheat	Kando	Durum Wheat	Olaf	Spring Wheat	Waldron	Spring Wheat	Crosby	Durum Wheat	Beacon Barley	Laing Oats	Hector Barley	Kelsey Oats	Laing Oats	Olaf	Spring Wheat	Hector Barley	Kelsey Oats	Kando	Durum Wheat	Crosby	Durum Wheat	Waldron	Spring Wheat	Beacon Barley	Border	Crosby	Durum Wheat	Olaf	Spring Wheat	Waldron	Spring Wheat	Laing Oats	Kelsey Oats	Kando	Durum Wheat	Beacon Barley	Hector Barley	Kando	Durum Wheat	Beacon Barley	Kelsey Oats	Olaf	Spring Wheat	Crosby	Durum Wheat	Hector Barley	Waldron	Spring Wheat	Laing Oats	Bare Soil	Winter Wheat

Fallow in 1976

Wheat in 1976

## Appendix III

## Brief Description of Supporting or Ancillary Measurements

Intensive Test Site

An inventory of all fields including crop species, crop variety, field acreage, and planting date was obtained, once in the spring and once in the fall. Rainfall amounts were noted at selected places in the site during the crop year.

Periodic observations of large fields under helicopter flight lines include:

- o Crop species
- o Cultural practices: fertilization, planting date, etc.
- o Crop Maturity
- o Plant height
- o Ground cover
- o Stresses: disease, insects, moisture deficits, etc.
- o Field operations: cultivation, harvesting, etc.
- o Vertical and oblique photographs
- o Grain yield

At selected fields under the helicopter flight lines for the Finney County, Kansas and Hand County, South Dakota test sites, the following additional observations were made:

- o Leaf area
- o Fresh and dry biomass
- o Vertical and oblique photographs
- o Soil moisture samples
- o Yield measurements

Meteorological and atmospheric measurements collected at the base station for each site during the helicopter and aircraft flights include:

- o Percent cloud cover and type
- o Temperature
- o Relative humidity
- o Wind speed and direction
- o Barometric pressure
- o Total irradiance
- o Optical depth

Agriculture Experiment Station

Supporting measurements collected at the plots on the agriculture experiment stations include:

- o Crop species and variety
- o Cultural practices: fertilization, planting date, etc.
- o Crop maturity
- o Plant height
- o Plant counts
- o Ground cover
- o Stresses: disease, insects, moisture deficits, etc.
- o Leaf area
- o Fresh and dry biomass
- o Soil moisture measurements
- o Yield measurements
- o Vertical and oblique photographs

Meteorological and atmospheric measurements include a daily record of the temperature variation and precipitation amounts recorded at the experiment station for the crop year. The measurements also include during the time that spectral data were collected:

- o Percent cloud cover and type
- o Temperature
- o Relative humidity
- o Wind speed and direction
- o Barometric pressure
- o Total irradiance
- o Optical depth (only at Garden City, Kansas Agricultural Experiment Station)

Crop Canopy Modeling Field

Supporting measurements on the crop canopy modeling field include:

- o Crop species and variety
- o Crop maturity
- o Plant height
- o Plant counts
- o Stresses: disease, insects, moisture deficits, etc.
- o Leaf area
- o Stem area
- o Head area
- o Fresh and dry biomass
- o Canopy modeling photographs
- o Skylight: shaded vs non-shaded field reflectance standard (Exotech Model 100 measurements)

Appendix IV

LACIE Field Measurements Sensor Data Specificifications and Operational Characteristics

SPECIFICATIONS

OPERATIONAL CHARACTERISTICS

Sensor	Type	Spectral Bands	Spectral range, micrometer	Spot size IFOV, m	Swath width, m	Altitude of Operation, m	Site of Operation
Landsat	Imagery	4	0.5 to 1.1	79 x 57	$1.9 \times 10^5$	$9.3 \times 10^5$	ITS
Aircraft MSS	Imagery	15 9	0.34 to 2.36 3.54 to 13.00	12 6 0.9	10 230 5 115 760	6 100 3 050 460	ITS ITS ITS; experiment station
Aircraft M2s	Imagery	10 1	0.4 to 1.1 8.0 to 13.0	15 8 1.2	14 520 7 265 1 090	6 100 3 050 460	ITS ITS ITS; experiment station
Helicopter FSS	Non-imagery	61 12	0.4 to 2.4 8.0 to 14.0	24	(a)	60	ITS
FSAS	Non-imagery	201	0.4 to 2.4	1.2 to 1.8 to	(a)	6 to 9 to	Experiment station ITS calibration panels
Exotech 20C	Non-imagery	201 188	0.4 to 2.4 2.8 to 13.4	1.7	(a)	6	Experiment station ITS calibration panels
Exotech 100	Non-imagery	4	0.5 to 1.1	0.4 to 0.5 to	(a)	1.5 to 2.0 to	Canopy modeling field

(a) Not applicable.