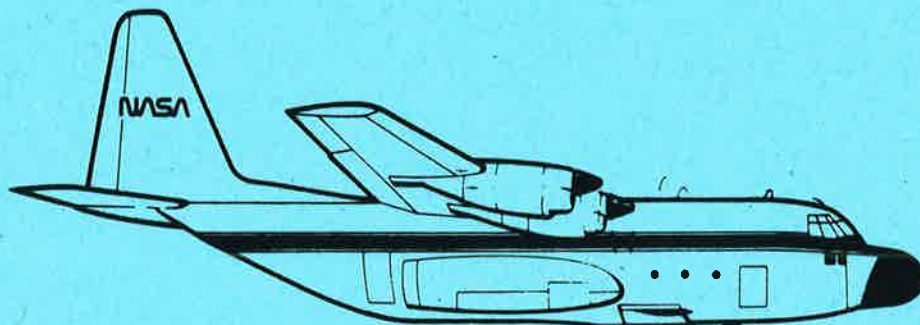# Airborne Instrumentation Research Project

Flight Summary Report

Flight No. 86-009-07

Date 19 September 1986

FSR-

NASA

National Aeronautics and
Space Administration

Ames Research Center
Moffett Field, California 94035

Airborne Missions and Applications Division

FLIGHT SUMMARY REPORT

Flight Number: 86-009-07

Date: 19 September 1986

Julian Date: 262

Sensor Package: Zeiss Camera;
                NS001 Multispectral Scanner

Aircraft No: 707

Purpose of Flight: #0986 Support
                    Requestor: Peterson
                    #2016 Support
                    Requestor: Vane/Starr

Area(s) Covered: Cerro Pelon, NM (site 160)
                  Grover City, CA (site 165)
                  29 Palms, CA (site 164)
                  San Dimas Forest, CA (site 87)

SENSOR DATA

Accession No:	03601	03605	---
Sensor ID No:	077	085	072
Sensor Type:	Zeiss	Zeiss	NS001
Focal Length:	6" 153.412mm	12" 305.105mm	---
Film Type:	Aerochrome Infrared, 2443	Ektachrome EF Aerographic, SO-397	---
Filtration:	Wratten 12+.36av	---	---
Spectral Band:	510-900nm	400-700nm	see write-up
f Stop:	4	5.6	---
Shutter Speed:	1/200	1/400	---
No. of Frames:	45	50	---
% Overlap:	variable	variable	---
Quality:	Good	Good	---
Remarks:	---	---	---

FLIGHT SUMMARY

86-009-07

This flight was flown in support of Flight Requests #0986 (Peterson, NASA/ARC), #2016 (Vane/Starr, JPL) amd #1095B (Brass, NASA/ARC) under the FY 1986 Airborne Instrumentation Research Program (AIRP) plan. NS001 multispectral scanner and zeiss color and color infrared photography were acquired over selected sites in New Mexico and California (No Track Map).

Minor cumulus cloud cover was encountered over the San Dimas forest in California. No other camera or processing malfunctions were noted and the quality of the data is rated good.

NS001 Multispectral Scanner

The NS001 Multispectral Scanner used on the C-130B aircraft contains the seven Landsat-D Thematic Mapper bands plus a band from 1.13 to 1.35 micrometers. The specific bands are:

Band	Spectral bandwidth, um
1	.458 - .519
2	.529 - .603
3	.633 - .697
4	.767 - .910
5	1.13 - 1.35
6	1.57 - 1.71
7	2.10 - 2.38
8	10.9 - 12.3

Sensor specifications are:

IFOV	2.5 mrad
Total scan angle	100°
Pixels/scan line	699

The format of the flight data consists of 838 8-bit words per frame (data for one wavelength band throughout a scan line). Of these, 699 are the video information and the remainder are information on Greenwich time, scan line number, calibration lamp voltage and current, blackbody temperatures, etc.

Computer compatible tapes (CCTs) are produced from the flight tapes, and consist of header informaiton followed by scanner video data.

NS001 SCANNER DATA TAPE FORMAT

The Applications Aircraft Data Management Facility converts scanner data recorded on 14-track high-density tape to standard 9-track computer-compatible tapes (CCT) for the user. Density of CCTs can be 6250, 1600, or 800 bpi, depending on the user's preference. The logical record length is fixed at 750 8-bit bytes for raw data and 1004 bytes for geometrically corrected data. The first 50 bytes for all records are house-keeping information; the next 699 (or 953 for geometrically corrected data) are digitized pixel data. A single "filler" byte is added at the end of each logical record to maintain even-numbered lengths.

All channels for a particular flight segment are written in a single tape file in line-interleaved format, as follows:

> record 1 = scanline 1, channel 1
> record 2 = scanline 1, channel 2
> record 3 = scanline 1, channel 3
> •
> •
> •
> record 8 = scanline 1, channel 8
> record 9 = scanline 2, channel 1
> etc.

Users can request that tapes be blocked to contain all channels of a single scanline sequentially in one record. In such cases physical record length equals the number of channels multiplied by the logical record length (750 or 1004 bytes).

NS001
USER TAPE
LOGICAL RECORD FORMAT

16-BIT WORD NUMBER	CONTENTS OF WORD
1-25	Channel Scanline Housekeeping Information
1	Data Frame Status

	0 Good frame
	10 Interpolated data
	20 Repeated data
	30 Zero-fill for data

Word	Contents
2	Radiance Per Count Calibration Values
	. Visible channel (1-7) flight calibration values modified for gain as follows: integer, tens of nanowatts per square centimeter per micron per steradian per count.
	. Thermal channel is not used.
3-4	Scanline Count (32-bit integer)
5	Black Body 1 Thermistor Count
6	Black Body 2 Thermistor Count
7	Black Body 1 Thermal Reference Temperature (degrees C X 100)
8	Black Body 2 Thermal Reference Temperature (degrees C X 100)
9	Scan Speed (X 100)
10	GMT Hours
11	GMT Minutes
12	GMT Seconds (X 10)
13	Demagnification Value (X 100)
14	Total Air Temperature (TAT) Degrees Celcius X 10
15	Gain Value (X 1000)
	. Visible channel (1-7) gain value is defined as as 1000 times (word 24 minus word 19) divided by (the laboratory value of reference lamp less tare).
	. Thermal channel (8) is not used.
16	Channel Number
17-18	Time (GMT) Expressed as a 7-digit number HHMMSST (32-bit integer)
19	Black Body 1 Radiance Count
20	Black Body 2 Radiance Count
21	Reference Lamp Voltage
22	Reference Lamp Current
23	Reference Lamp State (16 bits 000000000ab00000)
	a=1 means reference lamp selected as visible high-level calibration source
	b=0 means lamp has degraded below predetermined level of 12.8V
	b=1 means lamp has not degraded below predetermined level
24	Reference Lamp Radiance Count
25	Precision Radiation Thermometer (PRT-5) Degrees Celcius X 10

16-BIT WORD
   NUMBER   CONTENTS OF WORD

   26-375   Digitized Video Pixel Information (see note below)

    26   Digitized Video Pixels #699 and #698
    27   Digitized Video Pixel #697 and #696
    .
    .
    .
   375   Byte 1 is Digitized Video Pixel #1
              Byte 2 is filler

NOTE: Housekeeping information consists of 16-bit integers, unless otherwise
     noted. Video pixel data consists of two 8-bit samples packed into one
     16-bit word. Geometrically corrected data contains 953 pixels,
     expanding the logical record format to 502 words. Digitized video
     pixels are reversed to compensate for the fact that the NS001 scans
     right to left; pixel no. 1 is the leftmost pixel, and pixel no. 2
     is the rightmost.

SCANNER FLIGHT LINE DATA
FLIGHT NO. 86-009-07

NS001 FLIGHT DATA
FLIGHT NUMBER: 86-009-07

Check points	flightline number	Actual time (GMT) begin	end	Actual scanline begin	end	Altitude feet/meter	Scan Speed (rps)	total Good scanlines	total Interpolated scanlines	total Repeated scanlines	total Zero-fill scanlines
S160L1R1	1	17:38:11.7	17:41:34.8	96	3548	11700/ 3566	17.00	3451	0	2	0
S160L1R2	2	17:49:16.0	17:51:11.1	11389	13345	11800/ 3596	17.00	1957	0	0	0
S160L1R3	3	18:11:57.6	18:15:51.3	25855	28660	18000/ 5486	12.00	2804	0	2	0
S160L1R4	4	18:23:30.6	18:28: 5.5	33382	36469	18100/ 5516	11.00	1405	0	1683	0
S164L1R1	5	20:28:29.1	20:32:41.4	115928	118952	22500/ 6857	12.00	3019	0	6	0
S164L1R2	6	20:39:58.7	20:44: 1.9	123763	126438	21700/ 6614	11.00	2676	0	0	0
S87L1R1	7	21:05:53.8	21:08:16.0	143348	146563	16200/ 4937	23.00	3180	0	36	0
S165L1R1	8	21:53:59.3	21:56: 7.6	181841	183381	29700/ 9052	12.00	1541	0	0	0
S165L2R1	9	22:01:22.6	22:04:27.0	187161	189374	24900/ 7589	12.00	2212	0	2	0
S165L2R2	10	22:11:22.8	22:15: 6.6	194315	196777	24900/ 7589	11.00	2456	0	7	0

NS001 SCANNER CALIBRATION VALUES

NS001 CALIBRATION VALUES

FLIGHT LINE	Channel 1 TARE	Channel 1 CALIB	Channel 2 TARE	Channel 2 CALIB	Channel 3 TARE	Channel 3 CALIB	Channel 4 TARE	Channel 4 CALIB	Channel 5 TARE	Channel 5 CALIB	Channel 6 TARE	Channel 6 CALIB	Channel 7 TARE	Channel 7 CALIB	Channel 8 REF SOURCE (Degrees C) BB1	Channel 8 REF SOURCE (Degrees C) BB2	Channel 8 RESPONSE (Counts) BB1	Channel 8 RESPONSE (Counts) BB2	Degrees per Count
1	9	49.7*	13	50.6	12	70.4	13	53.5	15	22.9	11	12.8	14	4.54	14.93	34.43	20.0	146.2	.154
2	9	50.5*	13	51.3	13	70.6	13	52.2	15	23.0	11	12.5	14	4.50	14.90	34.45	20.2	177.3	.124
3	10	52.8*	15	52.7	13	71.5*	15	51.8	18	23.8	12	12.2	17	4.50	14.59	34.18	20.5	128.6	.181
4	9	54.0*	15	53.5	13	71.7*	15	50.7	17	24.0	11	11.8	17	4.49	14.50	33.48	20.8	161.5	.135*
5	10	54.2*	15	61.6*	14	72.5*	16	53.4	16	24.7	12	13.2	18	4.93	17.10	38.16	21.0	90.8	.302
6	11	54.7*	15	66.5	15	72.5	16	53.2	16	25.9	12	13.1	18	4.93	17.10	38.27	20.8	127.0	.199
7	9*	53.5*	14*	66.5*	13*	72.1*	14*	50.9*	15*	25.4*	13*	11.5	14*	4.89	17.50	38.60	20.7	138.2	.180*
8	10	52.5*	15	64.7	14	72.3	16	53.0	16	25.3	12	12.6	18	4.91	17.20	38.20	21.1	139.2	.178
9	11	53.0*	15	65.3	14	72.7	16	52.3	16	25.3	12	12.4	18	4.85	17.10	38.44	21.4	137.5	.184
10	10	54.3*	15	66.0	14	72.9	16	51.4	16	25.5	12	12.1	18	4.87	17.00	38.54	21.6	134.1	.191

* This value varied excessively over the flightline.

1. TARE value in digital counts.
2. CALIB in (Microwatts/square CM/Micron/steradian) per count.
3. Word 19 of each scanline is CALIB times 100.

UNITS: MICROWATTS PER SQUARE CENTIMETER PER MICRON PER STERADIAN

Calibration Procedures for Visible Bands

To obtain calibrated ground radiance, subtract the black body radiance count tare value (contained in word 19 of each tape scanline record) from the digital video counts (contained in words 26 through 375). Multiply the results by the calibration value (word 2). This calibration value is derived from a laboratory measurement using a known radiance and a gain value deduced from the in-flight reference lamp count. Black Body No. 1 (BB1) has been used throughout for consistency in the determination of the tare value.

A detailed account of NS001 calibration procedures is obtainable from NASA Airborne Missions and Applications Division. The calibration values listed on this page were generated by the Applications Aircraft Data Management Facility.

CAMERA FLIGHT LINE DATA
FLIGHT NO   86-009-07

acc# 03605

Sensor #	Check Points	Frame Numbers	Time (GMT-hr, min, sec) START	Time (GMT-hr, min, sec) END	Altitude, MSL feet/meters	Cloud Cover/Remarks
085 SO-397	S160L1R1	---	---	---	---	no photo
	S160L1R2	0046-0052	17:49:21	17:50:47	11800/3598	Cerro Pelon, NM
	S160L1R3	0053-0058	18:14:20	18:15:47	18000/5488	Cerro Pelon, NM
	S160L1R4	---	---	---	---	no photo
	S164L1R2	0059-0064	20:28:36	20:32:22	22500/6859	29 Palms, CA
	S164L1R2	0065-0071	20:40:09	20:43:57	21700/6616	29 Palms, CA
	S87L1R1	0072-0080	21:06:04	21:08:11	16200/4939	San Dimas, CA frames 0072-0076 minor cumulus
	S165L1R1	0081-0084	21:54:12	21:56:02	24700/7530	Grover City, CA
	S165L2R1	0085-0089	22:01:34	22:04:22	24900/7591	Grover City, CA
	S165L2R2	0090-0095	22:11:35	22:15:02	24900/7591	Grover City, CA

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CAMERA FLIGHT LINE DATA
FLIGHT NO. 86-009-07

Sensor #	Check Points	Frame Numbers	Time (GMT-hr, min, sec)		Altitude, MSL feet/meters	Cloud Cover/Remarks
			START	END		
077 2443	S160L1R1	---	---	---	---	no photo coverage
	S160L1R2	0139-0142	17:49:21	17:50:47	11800/3598	Cerro Pelon, NM
	S160L1R3	0143-0146	18:14:20	18:15:47	18000/5488	Cerro Pelon, NM
	S160L1R4	---	---	---	---	no photo coverage
	S164L1R2	0147-0152	20:28:36	20:32:22	21200/6463	29 Palms, CA
	S164L1R2	0153-0159	20:40:09	20:43:57	21200/6463	29 Palms, CA
	S87L1R1	0160-0168	21:06:04	21:08:11	16200/4939	San Dimas Forest, CA frames 0160-0165 minor cumulus
	S165L1R1	0169-0172	21:54:12	21:56:02	24700/7530	Grover City, CA
	S165L2R1	0173-0177	22:01:34	22:04:22	24900/7591	Grover City, CA
	S165L2R2	0178-0183	22:11:35	22:15:02	24900/7591	Grover City, CA