FLIGHT SUMMARY REPORT

Flight Number: 93-161

Calendar/Julian Date: 09 September 1993 • 252

Sensor Package: Wild-Heerbrug RC-10
Dual Hycon HR-732
Modis Airborne Simulator (MAS)
Thematic Mapper Simulator (TMS)
Aerosol Particulate Sampler (APS)

Area(s) Covered: Rio Grande National Forest, Colorado

Investigator(s): Ishikawa, USFS

Aircraft #: 708

SENSOR DATA

Accession #:	04629	4630	4631
Sensor ID #:	076	039	020
Sensor Type:	RC-10	HR-732	HR-732
Focal Length:	12" 304.89 mm	24" 609.6 mm	24" 609.6 mm
Film Type:	High Definition Aerochrome IR SO-131	High Definition Aerochrome IR SO-131	High Definition Aerochrome IR SO-131
Filtration:	cc.10B	cc.10B	cc.10B
Spectral Band:	510-900 nm	510-900 nm	510-900 nm
f Stop:	4	8	8
Shutter Speed:	1/150	1/75	1/75
# of Frames:	237	357	66
% Overlap:	60	60	60
Quality:	Excellent	Excellent	Excellent
Remarks:	Camera clock offset 3.55 minutes from navigation data	Camera clock offset 0.6 sconds from navigation data	Shutter malfunction; camera clock offset 1.2 seconds from navigation data

Flight # 93-161
SENSOR DATA continued

Accession #:	-----	-----	-----
Sensor ID #:	108	074	024
Sensor Type:	MAS	TMS	APS
Focal Length:	-----	-----	-----
Film Type:	-----	-----	-----
Filtration:	-----	-----	-----
Spectral Band:	-----	-----	-----
f Stop:	-----	-----	-----
Shutter Speed:	-----	-----	-----
# of Frames:	-----	-----	-----
% Overlap:	-----	-----	-----
Quality:	Good	Very good	-----
Remarks:	-----	-----	-----

Airborne Science and Applications Program

The Airborne Science and Applications Program (ASAP) is supported by three ER-2 high altitude Earth Resources Survey aircraft. These aircraft are operated by the High Altitude Missions Branch at NASA-Ames Research Center, Moffett Field, California. The ER-2s are used as readily deployable high altitude sensor platforms to collect remote sensing and *in situ* data on earth resources, celestial phenomena, atmospheric dynamics, and oceanic processes. Additionally, these aircraft are used for electronic sensor research and development and satellite investigative support.

The ER-2s are flown from various deployment sites in support of scientific research sponsored by NASA and other federal, state, university, and industry investigators. Data are collected from deployment sites in Kansas, Texas, Virginia, Florida, and Alaska. Cooperative international scientific projects have deployed the aircraft to sites in Great Britain, Australia, Chile, and Norway.

Photographic and digital imaging sensors are flown aboard the ER-2s in support of research objectives defined by the sponsoring investigators. High resolution mapping cameras and digital multispectral imaging sensors are utilized in a variety of configurations in the ER-2s' four pressurized experiment compartments. The following provides a description of the digital multispectral sensor(s) and camera(s) used for data collection during this flight.

Thematic Mapper Simulator

The Daedalus Thematic Mapper Simulator (TMS) is a multispectral scanner flown aboard the ER-2 aircraft which simulates spatial and spectral characteristics of the seven Landsat-D Thematic Mapper bands. The specific bands are as follows:

Daedalus Channel	TM Band	Wavelength, *μm*
1	A	0.42 - 0.45
2	1	0.45 - 0.52
3	2	0.52 - 0.60
4	B	0.60 - 0.62
5	3	0.63 - 0.69
6	C	0.69 - 0.75
7	4	0.76 - 0.90
8	D	0.91 - 1.05
9	5	1.55 - 1.75
10	7	2.08 - 2.35
11	6	8.5 - 14.0 low gain
12	6	8.5 - 14.0 high gain

Sensor/aircraft parameters are as follows:

IFOV:	1.25 mrad
Ground Resolution:	81 feet (25 meters) at 65,000 feet
Total Scan Angle:	43°
Swath Width:	8.4 nmi (15.6 km) at 65,000 feet
Pixels/Scan Line:	716
Scan Rate:	12.5 scans/second
Ground Speed:	400 kts (206 m/second)

NOTE: Information on data tape format, logical record format, and scanner calibration data may be obtained from the Aircraft Data Facility, NASA-Ames Research Center, Mail Stop 240-6, Moffett Field, California 94035-1000 (Telephone: 415-604-6252).

Modis Airborne Simulator

The Modis Airborne Simulator (MAS) is a modified Daedalus multispectral scanner. It records up to twelve 8-bit channels, which can be selected from an array of fifty available spectral bands. The band selection is made prior to flight and the instrument is hard-wired to that configuration. The following MAS band combination (configuration LMSC) was used on this flight:

Data System Channel	MAS Channel	Band edges µm
1	--	-------
2	1	0.529 - 0.572
3	2	0.635 - 0.688
4	8	0.896 - 0.927
5	10	1.595 - 1.652
6	14	1.805 - 1.855
7	15	1.855 - 1.905
8	16	1.905 - 1.955
9	31	3.659 - 3.810
10	42	8.342 - 8.738
11	44	10.259 - 10.725
12	46	11.799 - 12.246

Sensor/Aircraft Parameters:

Spectral Channels:	50
Output Channels:	Twelve 8-bit
IFOV:	2.5 mrad
Ground Resolution:	163 feet (50 meters at 65,000 feet)
Total Scan Angle:	85.92°
Pixels/Scan Line:	716
Scan Rate:	6.25 scans/second
Ground Speed:	400 kts (206 m/second)
Roll Correction:	Plus or minus 3.5 degrees (approx.)

Aerosol Particulate Sampler

The Aerosol Particulate Sampler (APS) has been developed and is operated by Dr. Guy Ferry of the NASA-Ames Research Experiments Branch. The sampler is a non-imaging sensor designed to gather high altitude dust particles for laboratory research.

Camera Systems

Various camera systems and films are used for photographic data collection. Film types include high definition color infrared, natural color, and black and white emulsions. Available photographic systems are as follows:

- Wild-Heerbrug RC-10 metric mapping camera
  - 9 x 9 inch film format
  - 6 inch focal length lens provides area coverage of 16 x 16 nautical miles from 65,000 feet
  - 12 inch focal length lens provides area coverage of 8 x 8 nautical miles from 65,000 feet

- Hycon HR-732 large scale mapping camera
  - 9 x 18 inch film format
  - 24 inch focal length lens provides area coverage of 4 x 8 nautical miles from 65,000 feet

- IRIS II Panoramic camera
  - 4.5 x 34.7 inch film format
  - 24 inch focal length lens
  - 90 degree field of view provides area coverage of 2 x 21.4 nautical miles from 65,000 feet

The U.S. Geological Survey's EROS Data Center at Sioux Falls, South Dakota serves as the archive and product distribution facility for NASA-Ames aircraft acquired photographic and digital imagery. For information regarding photography and digital data (including areas of coverage, products, and product costs) contact EROS Data Center, Customer Services, Sioux Falls, South Dakota 57198 (Telephone: 605-594-6151).

For specific information regarding flight documentation, sensor parameters, and areas of coverage contact the Aircraft Data Facility, NASA-Ames Research Center, Mail Stop 240-6, Moffett Field, California 94035-1000 (Telephone: 415-604-6252). Additional information regarding ER-2 acquired photographic and digital data is also available through the Aircraft Data Facility.

CAMERA FLIGHT LINE DATA
FLIGHT NO. 93-161

Accession # 04629

Sensor # 076

Check Points	Frame Numbers	Time (GMT-hr, min, sec) START	Time (GMT-hr, min, sec) END	Altitude, MSL feet/meters	Cloud Cover/Remarks
A - B	6029-6035	18:03:10	18:05:57	65000/19800	Clear
C - D	6036-6042	18:12:21	18:14:50	"	Clear
E - F	6043-6051	18:20:18	18:23:33	"	Clear
G - H	6052-6060	18:28:34	18:32:17	"	10% cumulus (frames 6056-6057); minor cumulus (frames 6055 and 6058)
I - J	6061-6072	18:38:00	18:42:57	"	10-30% cumulus (frames 6061-6066); 10% cumulus (frames 6070-6071); minor cumulus (frame 6072)
K - L	6073-6082	18:50:46	18:54:42	"	Minor cumulus (frame 6073); 20% cumulus (frames 6074-6076); minor cumulus (frames 6077-6078); 10-30% cumulus (frames 6079-6082)
M - N	6083-6090	19:00:31	19:03:34	"	Clear

CAMERA FLIGHT LINE DATA
FLIGHT NO. 93-161

Accession # 04629

Sensor # 076

Check Points	Frame Numbers	Time (GMT-hr, min, sec) START	Time (GMT-hr, min, sec) END	Altitude, MSL feet/meters	Cloud Cover/Remarks
O - P	6091-6119	19:08:01	19:20:54	65000/19800	10% cumulus (frame 6091); emulsion abrasion (frame 6107)
Q - R	6120-6146	19:24:42	19:36:40	"	10-20% cumulus (frames 6120-6124); 10-30% cumulus (frames 6128-6132); emulsion abrasion (frame 6130)
S - T	6147-6158	19:43:12	19:48:20	"	Very minor cumulus (frame 6153); 20-40% cumulus (frames 6154-6158)
U - V	6159-6170	19:51:59	19:56:44	"	10-40% cumulus (frames 6159-6164); minor cumulus (frame 6167); 10-20% cumulus (frames 6168-6170)
W - X	6171-6179	20:01:02	20:04:45	"	10-20% cumulus (frames 6171-6177); minor cumulus (frames 6178-6179)
Y - Z	6180-6188	20:18:56	20:22:39	"	10-50% cumulus (frames 6180-6186); minor cumulus (frame 6187); 10% cumulus (frame 6188)

CAMERA FLIGHT LINE DATA
FLIGHT NO. 93-161

Accession # 04629

Sensor # 076

Check Points	Frame Numbers	Time (GMT-hr, min, sec) START	Time (GMT-hr, min, sec) END	Altitude, MSL feet/meters	Cloud Cover/Remarks
1-2	6189-6199	20:27:27	20:31:53	65000/19800	10% cumulus (frames 6189-6190); 10-60% cumulus (frames 6191-6199)
3-4	6200-6223	20:40:31	20:51:13	"	10-50% cumulus (frames 6200-6212); 10% cumulus (frames 6219-6220)
5-6	6224-6251	20:57:21	21:09:57	"	10% cumulus (frame 6224); 10-50% cumulus (frames 6247-6251)
7-8	6252-6257	21:14:26	21:16:37	"	10% cumulus (frame 6252)
M - N	6258-6265	21:24:53	21:28:09	"	10% cumulus (frames 6258-6259); minor cumulus (frame 6261); 10-20% cumulus (frames 6262-6265)

CAMERA FLIGHT LINE DATA
FLIGHT NO. 93-161

Accession # 04630

Sensor # 039

Check Points	Frame Numbers	Time (GMT-hr, min, sec)		Altitude, MSL feet/meters	Cloud Cover/Remarks
		START	END		
A - B	0001-0013	18:07:19	18:10:06	65000/19800	Minor cirro-cumulus (frames 0006-0008)
C - D	0014-0024	18:16:23	18:18:47	"	Clear
E - F	0025-0038	18:24:19	18:27:25	"	Clear; emulsion abrasion (frame 0029)
G - H	0039-0055	18:32:35	18:36:25	"	Minor-10% cumulus (frames 0046-0050)
I - J	0056-0077	18:42:02	18:47:04	"	10% cirro-cumulus (frame 0056); 10-30% cumulus (frames 0058-0065); 10% cumulus (frames 0072-0075)
K - L	0078-0095	18:54:48	18:58:52	"	10-20% cumulus (frames 0079-0086); 10-30% cumulus (frames 0089-0095)
M - N	0096-0109	19:04:33	19:07:40	"	Clear
O - P	0110-0164	19:12:02	19:24:59	"	10% cumulus (frame 0110)
Q - R	0165-0215	19:28:44	19:40:45	"	Minor-30% cumulus (frames 0165-0174); 10-20% cumulus (frames 0181-0188)

CAMERA FLIGHT LINE DATA
FLIGHT NO. 93-161

Accession # 04630

Sensor # 039

Check Points	Frame Numbers	Time (GMT-hr, min, sec) START	Time (GMT-hr, min, sec) END	Altitude, MSL feet/meters	Cloud Cover/Remarks
S - T	0216-0237	19:47:16	19:52:19	65000/19800	Minor-40% cumulus (frames 0228-0237)
U - V	0238-0258	19:56:01	20:00:49	"	10-40% cumulus (frames 0238-0247); very minor cirro-cumulus (frames 0250-0254); 10% cumulus (frames 0255-0258)
W - X	0259-0274	20:05:04	20:08:40	"	10-20% cumulus (frames 0259-0270); 10% cumulus (frames 0273-0274)
Y - Z	0275-0291	20:22:59	20:26:49	"	10-50% cumulus (frames 0275-0288); 10% cumulus (frames 0290-0291); emulsion abrasion (frame 0278)
1 - 2	0292-0310	20:31:32	20:35:50	"	10% cumulus (frames 0292-0293); 10-70% cumulus (frames 0298-0310)
3 - 4	0311-0356	20:44:36	20:55:23	"	10-50% cumulus (frames 0311-0333); minor cumulus (frame 0334); 10% cumulus (frames 0348-0350)
5	357	21:01:29		"	10% cumulus

CAMERA FLIGHT LINE DATA
FLIGHT NO. 93-161

Accession # 04631

Sensor # 020

Check Points	Frame Numbers	Time (GMT-hr, min, sec) START	Time (GMT-hr, min, sec) END	Altitude, MSL feet/meters	Cloud Cover/Remarks
5-6	0001-0044	21:01:45	21:14:15	65000/19800	Very minor cumulus (frames 0029-0030); 10-40% cumulus (frames 0035-0044); double exposure (frame 0001)
7-8	0045-0052	21:18:35	21:20:45	"	Clear
M - N	0053-0066	21:29:00	21:32:35	"	10% cumulus (frames 0053-0054); 10-20% cumulus (frames 0058-0064); emulsion abrasion (frame 0062)

APS ON/OFF TIME 16:35:00/23:11:00

TMS SCANNER FLIGHT LINE DATA

FLIGHT NO. 93-161

DAEDALUS FLIGHT DATA
FLIGHT NUMBER: 93-161

Check Points	Actual time (GMT) begin	Actual time (GMT) end	Actual scanline begin	Actual scanline end	Altitude feet/meter	Scan Speed (rps)	total Good scanlines	total Interpolated scanlines	total Repeated scanlines
A-B	18:06:11.0	18:10:17.0	10147Ø	104539	65000/19812	12.50	3070	Ø	Ø
C-D	18:16:13.0	18:19:55.0	108994	111766	65000/19812	12.50	2773	Ø	Ø
E-F	18:23:37.0	18:27:42.0	114538	117607	65000/19812	12.50	3069	1	Ø
G-H	18:32:35.0	18:36:33.0	121270	124240	65000/19812	12.50	2971	Ø	Ø
I-J	18:41: 2.0	18:47: 6.0	127606	132160	65000/19812	12.50	4555	Ø	Ø
K-L	18:53: 3.0	18:58:59.0	136615	141070	65000/19812	12.50	4456	Ø	Ø
M-N	19:04:32.0	19:07:58.0	145228	147802	65000/19812	12.50	2575	Ø	Ø
O-P	19:11: 8.0	19:25:15.0	150178	160771	65000/19812	12.50	10593	1	Ø
Q-R	19:28:41.0	19:40:50.0	163345	172453	65000/19812	12.50	9108	1	Ø
S-T	19:47: 2.0	19:52:35.0	177106	181264	65000/19812	12.50	4159	Ø	Ø
U-V	19:55:37.0	20:01:18.0	183541	187798	65000/19812	12.50	4258	Ø	Ø
W-X	20:04:12.0	20:09:29.0	189976	193936	65000/19812	12.50	3960	1	Ø
Y-Z	20:22:33.0	20:27:26.0	203737	207400	65000/19812	12.50	3664	Ø	Ø
1-2	20:30:36.0	20:36:56.0	209776	214528	65000/19812	12.50	4753	Ø	Ø
3-4	20:43:48.0	20:56:28.0	219676	229180	65000/19812	12.50	9505	Ø	Ø
5-6	21:01: 6.0	21:14:42.0	232648	242845	65000/19812	12.50	10198	Ø	Ø
7-8	21:17:44.0	21:21:10.0	245122	247696	65000/19812	12.50	2575	Ø	Ø
M - N	21:27:46.0	21:32:39.0	252646	256309	65000/19812	12.50	3664	Ø	Ø

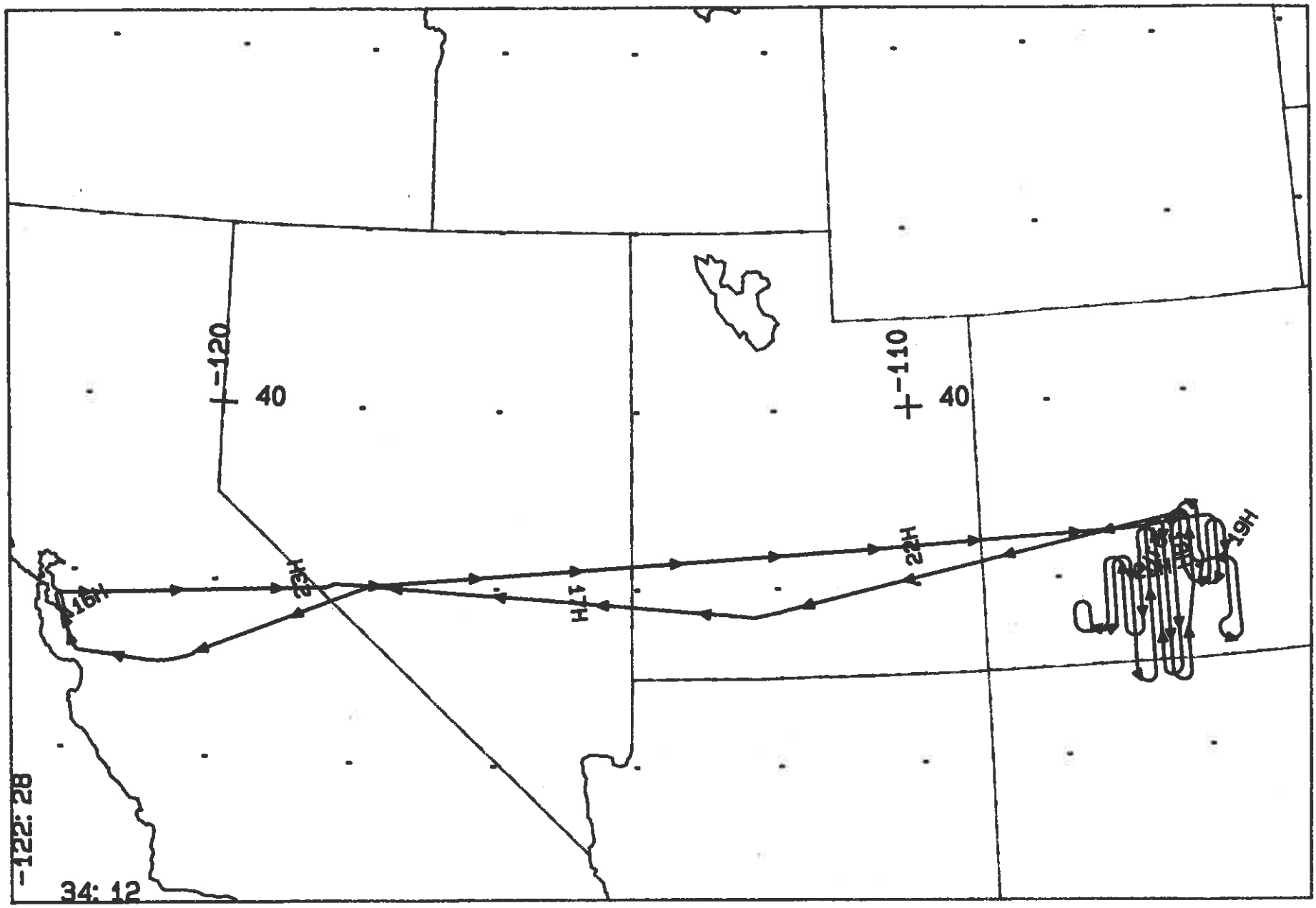
MAS SCANNER FLIGHT LINE DATA

FLIGHT NO. 93-161

DAEDALUS FLIGHT DATA
FLIGHT NUMBER: 93-161

Check Points	Actual time (GMT) begin	Actual time (GMT) end	Actual scanline begin	Actual scanline end	Altitude feet/meter	Scan Speed (rps)	total Good scanlines	total Interpolated scanlines	total Repeated scanlines
A-B	18:05:59.0	18:10:14.0	50432	52016	65000/19812	6.20	1585	0	0
C-D	18:16:35.0	18:19:46.0	54392	55580	65000/19812	6.20	1189	0	0
E-F	18:22:57.0	18:27:28.0	56768	58451	65000/19812	6.20	1684	0	0
G-H	18:32:30.0	18:36:29.0	60332	61817	65000/19812	6.20	1486	0	0
I-J	18:40:12.0	18:47: 5.0	63203	65777	65000/19812	6.20	2574	1	0
K-L	18:53:11.0	18:58:45.0	68054	70133	65000/19812	6.20	2080	0	0
M-N	19:04:35.0	19:07:46.0	72311	73499	65000/19812	6.20	1189	0	0
O-P	19:11:13.0	19:25:16.0	74786	80033	65000/19812	6.20	5248	0	0
Q-R	19:28:43.0	19:40:55.0	81320	85874	65000/19812	6.20	4554	1	0
S-T	19:47: 1.0	19:52:35.0	88151	90230	65000/19812	6.20	2080	0	0
U-V	19:55:30.0	20:01: 4.0	91319	93398	65000/19812	6.20	2080	0	0
W-X	20:04:15.0	20:09:33.0	94586	96566	65000/19812	6.20	1981	0	0
Y-Z	20:22:33.0	20:27:19.0	101417	103199	65000/19812	6.20	1782	1	0
1-2	20:30:46.0	20:36:36.0	104486	106664	65000/19812	6.20	2179	0	0
3-4	20:43:46.0	20:56:45.0	109337	114188	65000/19812	6.20	4852	0	0
5-6	21:01: 0.0	21:14:47.0	115772	120920	65000/19812	6.20	5149	0	0
7-8	21:17:42.0	21:21: 9.0	122009	123296	65000/19812	6.20	1288	0	0
M-N	21:27:47.0	21:32:33.0	125771	127553	65000/19812	6.20	1783	0	0

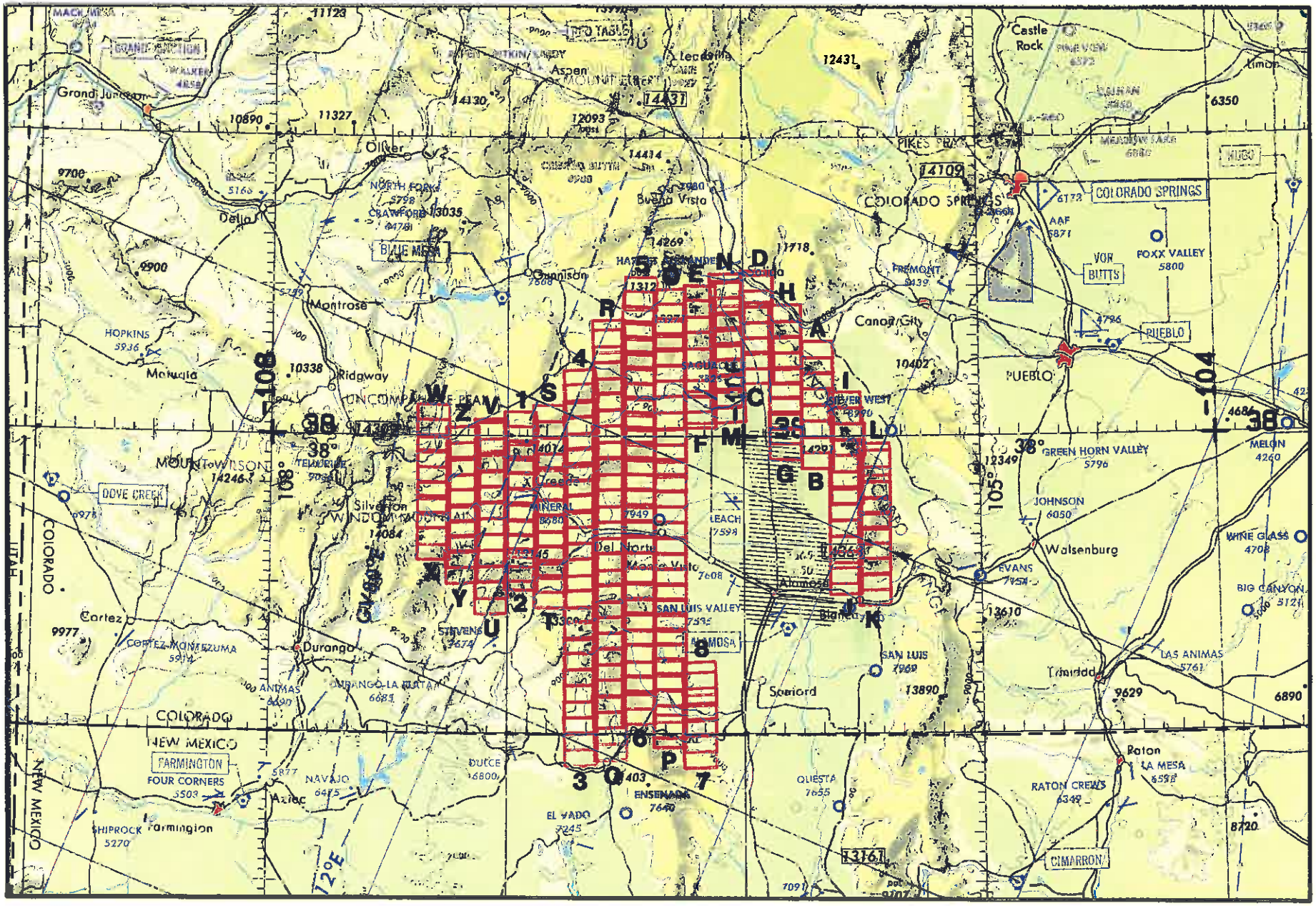
NOTE: Scan Speed (rps) is 6.25 NOT 6.20



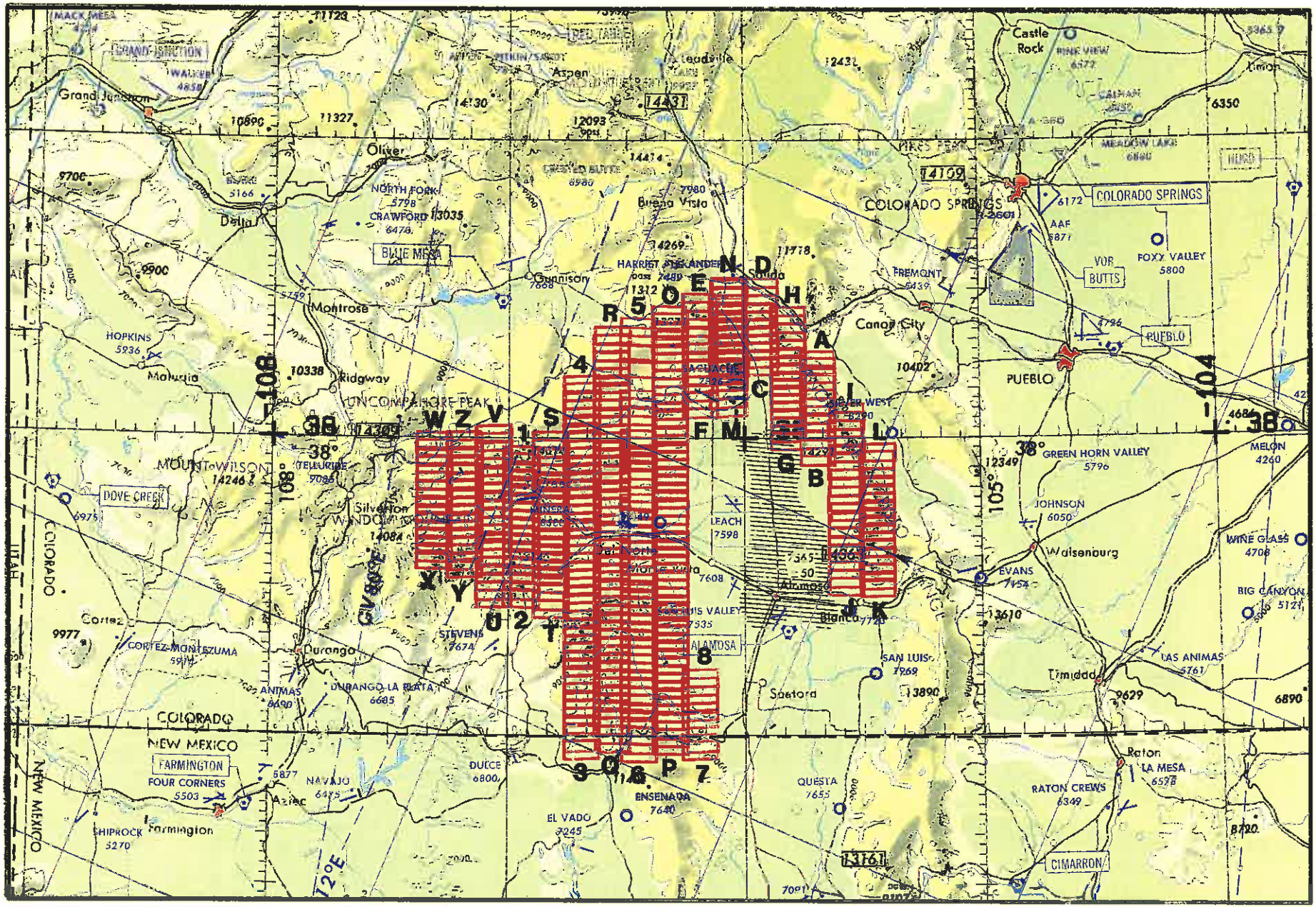
FLIGHT 93-161 9 SEPTEMBER 1993 A/C 708 RC-10 / DUAL HR-732 / NAS / TNS

OVERLAY FOR %CNOAH LAMBERT CONFORMAL PROJECTION: SP1 = 36.4 SP2 = 36.4 CM = -113.8 ROTATED BY 0.0

18:00:25 TO 23:38:35 UT SCALE = 1:6.73E+06 TIME TICS EVERY 10.00 MINUTES



FLIGHT 99-151 9 SEPTEMBER 1999 A/C 708 RC-10 / TMS / NAS JNC 44



FLIGHT 99-161 9 SEPTEMBER 1999 A/C 708 DUAL HR-732 JNC 44