FLIGHT SUMMARY REPORT

Flight Number: 93-160

Calendar/Julian Date: 08 September 1993 • 251

Sensor Package: Wild-Heerbrug RC-10
Airborne Visible and Infrared Imaging Spectrometer (AVIRIS)
Thematic Mapper Simulator (TMS)
Aerosol Particulate Sampler (APS)

Area(s) Covered: Central California

Investigator(s): Ustin, UC Davis; Davis, JPL **Aircraft #:** 708

SENSOR DATA

Accession #:	04628	-----	-----	-----
Sensor ID #:	076	099	074	024
Sensor Type:	RC-10	AVIRIS	TMS	APS
Focal Length:	12" 304.89 mm	-----	-----	-----
Film Type:	High Definition Aerochrome IR SO-131	-----	-----	-----
Filtration:	cc.10B	-----	-----	-----
Spectral Band:	510-900 nm	-----	-----	-----
f Stop:	4	-----	-----	-----
Shutter Speed:	1/125	-----	-----	-----
# of Frames:	121	-----	-----	-----
% Overlap:	60	-----	-----	-----
Quality:	Excellent	-----	Excellent	-----
Remarks:	Camera clock offset 2.2 seconds from navigation data			

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.

Airborne Visible and Infrared Imaging Spectrometer

The Airborne Visible and Infrared Imaging Spectrometer (AVIRIS) is the second in the series of imaging spectrometer instruments developed at the Jet Propulsion Laboratory (JPL) for earth remote sensing. This instrument uses scanning optics and four spectrometers to image a 614 pixel swath simultaneously in 224 contiguous spectral bands (0.4-2.4 μm).

AVIRIS parameters are as follows:

IFOV:	1 mrad
Ground Resolution:	66 feet (20 meters) at 65,000 feet
Total Scan Angle:	30°
Swath Width:	5.7 nmi (10.6 km) at 65,000 feet
Spectral Coverage:	0.41-2.45 μm
Pixels/Scan Line:	614
Number of Spectral Bands:	224
Digitization:	10-bits
Data Rate:	17 MBPS

Spectrometer	Wavelength Range	Number of Bands	Sampling Interval
1	0.41 - 0.70 μm	31	9.4 nm
2	0.68 - 1.27 μm	63	9.4 nm
3	1.25 - 1.86 μm	63	9.7 nm
4	1.84 - 2.45 μm	63	9.7 nm

All AVIRIS data is decommutated and archived at JPL and not currently available for public distribution. For further information contact Rob Green at Jet Propulsion Laboratory, 4800 Oak Grove Drive, Mail Stop 183-501, Pasadena, California 91109-8099.

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)

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).

Additional information regarding ER-2 acquired photographic and digital data is available through the Aircraft Data Facility at Ames Research Center. 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).

CAMERA FLIGHT LINE DATA
FLIGHT NO. 93-160

Accession # 04628

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	1863	20:54:42	_____	63000/19200	Clear
B - C	1864-1870	21:02:37	21:05:31	65000/19800	10% cumulus (frames 1869-1870); emulsion abrasion (frame 1867)
D - E	1871-1879	21:23:15	21:27:05	"	30-50% coastal stratus (frames 1878-1879)
F - G	1880-1889	21:32:07	21:36:25	"	50-100% strato-cumulus (frames 1880-1884); minor-30% strato-cumulus (frames 1885-1887); emulsion abrasions (frames 1881, 1885, 1889)
H - I	1890-1898	21:45:22	21:49:10	"	10% strato-cumulus (frame 1895); 30-90% strato-cumulus (frames 1896-1898); emulsion abrasions (frames 1890, 1893-1894)
J - K	1899-1908	21:55:55	22:00:11	"	30-100% strato-cumulus (frames 1899-1902); minor-10% stratus (frames 1903-1904); emulsion abrasions (frames 1900, 1902 and 1907-1908)

CAMERA FLIGHT LINE DATA
FLIGHT NO. 93-160

Accession # 04628

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
L - M	1909-1941	22:07:11	22:21:52	65000/19800	Minor-40% strato-cumulus (frames 1909-1912); minor-10% stratus (frames 1915-1916); 40-90% strato-cumulus (frames 1917-1922); 10% strato-cumulus (frame 1923); 10-80% strato-cumulus (frames 1936-1941); emulsion abrasions (frames 1909, 1918, 1933 and 1938)
N - D	1942-1968	22:27:32	22:39:49	"	Clear; emulsion abrasions (frames 1946, 1949, 1951, 1954 and 1957-1958)
K - O	1969-1983	22:43:41	22:50:18	"	Minor stratus (frames 1876-1877); emulsion damage (frames 1973, 1977-1978 and 1983); stepwedge overprint (frames 1981 and 1983)

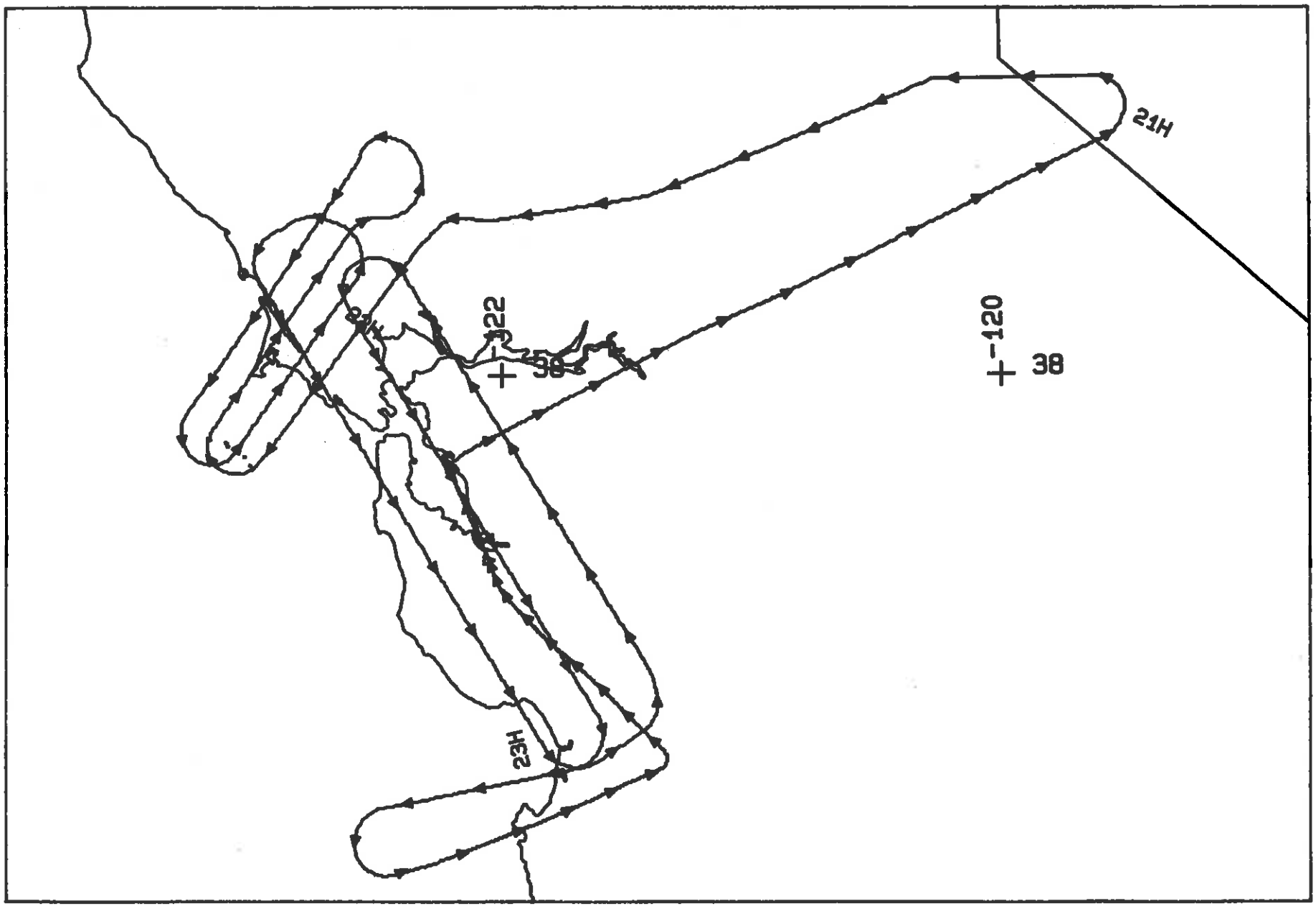
APS ON/OFF TIME 20:52:00/22:52:00

TMS SCANNER FLIGHT LINE DATA

FLIGHT NO. 93-160

DAEDALUS FLIGHT DATA
FLIGHT NUMBER: 93-160

Check Points	Actual time (GMT) begin	end	Actual scanline begin	end	Altitude feet/meter	Scan Speed (rps)	total Good scanlines	total Interpolated scanlines	total Repeated scanlines
B-C	21:01:42.0	21:05:41.0	31720	34670	65000/19812	12.50	2771	0	0
D-E	21:21:48.0	21:28:39.0	46768	51916	65000/19812	12.50	5149	0	0
F-G	21:31:42.0	21:38: 2.0	54193	58745	65000/19812	12.50	4753	0	0
H-I	21:44:12.0	21:52:15.0	63577	69616	65000/19812	12.50	6040	0	0
J-K	21:55:18.0	22:00:38.0	71893	75850	65000/19812	12.50	4258	0	0
L-M	22:06:31.0	22:21:50.0	80308	91792	65000/19812	12.50	11485	0	0
N-D	22:27:46.0	22:40:25.0	96247	105751	65000/19812	12.50	9504	1	0
K-O	22:43:52.0	22:51:55.0	108325	114364	65000/19812	12.50	6040	0	0



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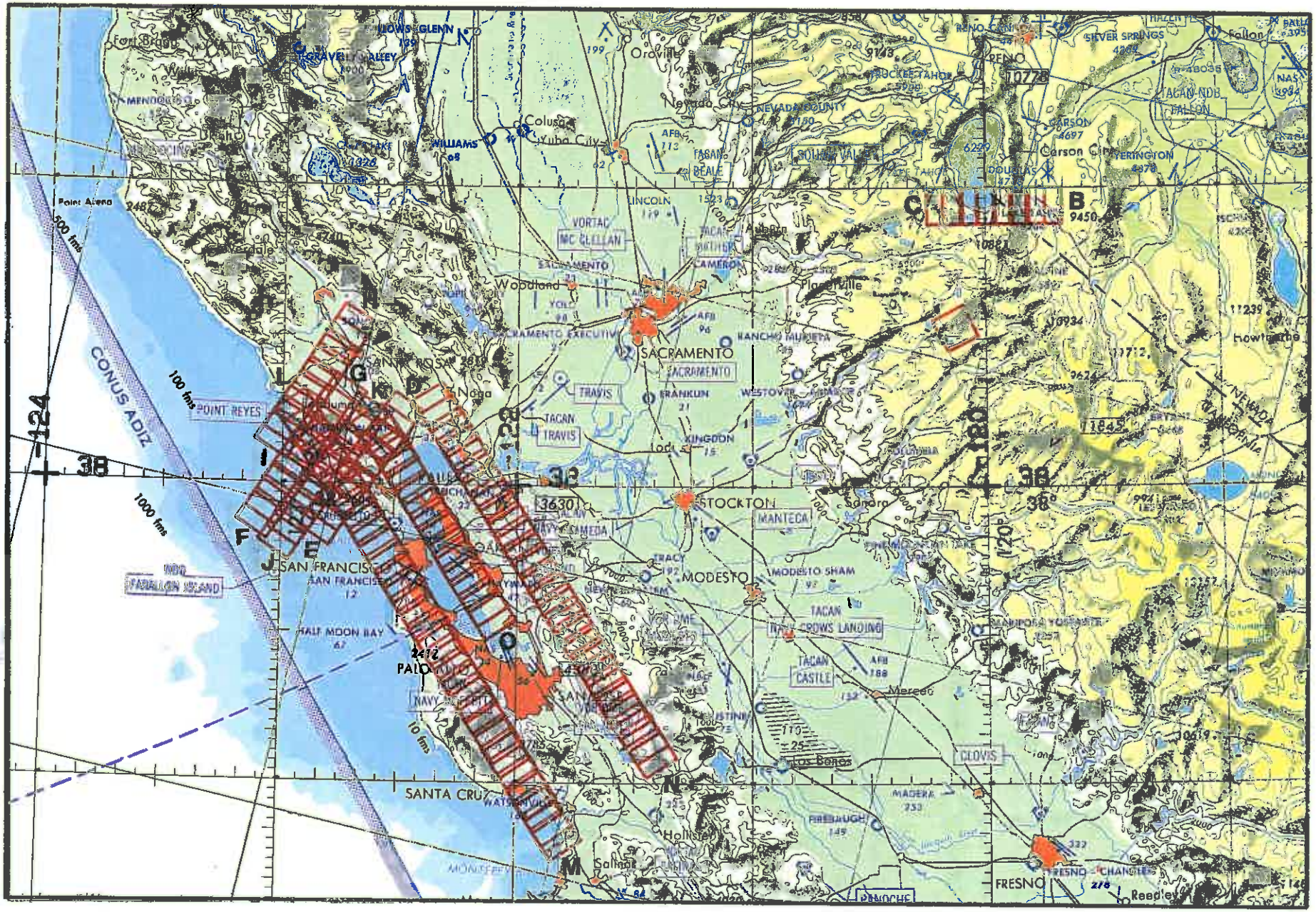
SACRAMENTO
STOCKTON
MODESTO
SAN FRANCISCO
SANTA CRUZ
FRESNO
POINT REYES
CONUS ADIZ
100 fms
500 fms
1000 fms
10 fms
-124
38
Woodland
Davis
Vacaville
Fairfield
Napa
Petaluma
Santa Rosa
Lodi
Manteca
Tracy
Merced
Los Banos
Hollister
Salinas
Reedley
Clovis
Placerville
Auburn
Colusa
Yuba City
Oroville
Reno
Fallon
Carson City
Lincoln
Travis
Mather
Beale
Crows Landing
Castle
Moffett
Half Moon Bay
Palo Alto
Point Arena
Fort Bragg
Ukiah
Williams
Grindstone
Alley
Gravelly
Mendocino
Farallon Island
Monterey
Watsonville
Fresno Chandler
Madera
Firebaugh
Penoche
Sonora
Columbia
Jamestown
Tuolumne
Mariposa
Yosemite
Nevada City
Nevada County
Truckee-Tahoe
Silver Springs
Stillwater
Lovelock
Gerlach
Winnemucca
Hawthorne
Tonopah
Bridgeport
Mono Lake
Lake Tahoe
Susanville
Alturas
Klamath Falls
Lakeview
Burns
Bend
Redmond
Madras
Prineville
Sisters
Crescent
Chemult
Klamath
Medford
Grants Pass
Roseburg
Eugene
Corvallis
Albany
Salem
Portland
Astoria
Tillamook
Newport
Florence
Coos Bay
North Bend
Brookings
Crescent City
Eureka
Arcata
Fortuna
Willits
Ukiah
Clear Lake
Lakeport
Healdsburg
Santa Rosa
Petaluma
Novato
San Rafael
Sausalito
Oakland
Alameda
Hayward
San Leandro
San Mateo
Redwood City
Menlo Park
Palo Alto
Mountain View
Sunnyvale
Santa Clara
San Jose
Milpitas
Fremont
Livermore
Pleasanton
Dublin
San Ramon
Walnut Creek
Concord
Martinez
Pittsburg
Antioch
Brentwood
Oakley
Byron
Tracy
Lathrop
Ripon
Escalon
Oakdale
Riverbank
Turlock
Modesto
Ceres
Hughson
Waterford
Patterson
Newman
Gustine
Los Banos
Dos Palos
Firebaugh
Mendota
Coalinga
Huron
Avenal
Kettleman City
Lemoore
Hanford
Corcoran
Kingsburg
Selma
Fowler
Parlier
Reedley
Dinuba
Sanger
Orange Cove
Kingsburg
Tulare
Visalia
Exeter
Lindsay
Strathmore
Porterville
Terra Bella
Ducor
Earlimart
Delano
Wasco
Shafter
Bakersfield
Arvin
Lamont
Weedpatch
Edison
Buttonwillow
Taft
Maricopa
Fellows
McKittrick
Midway City
Cuyama
New Cuyama
Santa Maria
Orcutt
Guadalupe
Lompoc
Vandenberg AFB
Santa Barbara
Goleta
Carpinteria
Ventura
Oxnard
Port Hueneme
Camarillo
Point Mugu
Thousand Oaks
Simi Valley
Moorpark
Fillmore
Santa Paula
Ojai
Piru
Castaic
Newhall
Saugus
Valencia
Canyon Country
Palmdale
Lancaster
Rosamond
Edwards AFB
Mojave
Tehachapi
Keene
Lebec
Frazier Park
Gorman
Pyramid Lake
Elizabeth Lake
Quartz Hill
Littlerock
Pearblossom
Palmdale
Victorville
Apple Valley
Hesperia
Adelanto
Barstow
Daggett
Yermo
Fort Irwin
Baker
Death Valley Junction
Furnace Creek
Stovepipe Wells
Panamint Springs
Trona
Ridgecrest
China Lake
Inyokern
Kernville
Isabella
Lake Isabella
Onyx
Weldon
Wofford Heights
Glennville
Bodfish
Caliente
Tehachapi
Mojave
Rosamond
Edwards AFB
Lancaster
Palmdale
Littlerock
Pearblossom