FLIGHT SUMMARY REPORT

Flight Number: 98-086

Calendar/Julian Date: 11 July 1998 • 192

Sensor Package: Wild Heerbrugg RC-10
Airborne Visible and Infrared Imaging Spectrometer (AVIRIS)
Modis Airborne Simulator (MAS)
Microwave Temperature Sounder
NOPESS Aircraft Sounder Testbed (NAST-I)
High-Resolution Interferometer Sounder (HIS)

Area(s) Covered: New England/Mid-Atlantic Coast

Investigator(s): Mustard, Brown University;
Bagheri, NJ Institute of Technology;
Ackleson, Office of Naval Research;
Smith, Langley Research Center

Aircraft #: 809

SENSOR DATA

Accession #:	05266	-----	-----	-----	-----
Sensor ID #:	034	099	108	122	083
Sensor Type:	RC-10	AVIRIS	MAS	NAST-I	HIS
Focal Length:	12” 304.66 mm	-----	-----	-----	-----
Film Type:	Aerochrome IR SO-134	-----	-----	-----	-----
Filtration:	Wratten 12	-----	-----	-----	-----
Spectral Band:	510-900 nm	-----	-----	-----	-----
f Stop:	11	-----	-----	-----	-----
Shutter Speed:	1/300	-----	-----	-----	-----
# of Frames:	62	-----	-----	-----	-----
% Overlap:	60	-----	-----	-----	-----
Quality:	Excellent	-----	-----	-----	-----
Remarks:	Subtract 8 seconds for correct UTC				

Airborne Science Program

The Airborne Science Program at NASA's Dryden Flight Research Center, Edwards, California, operates two ER-2 high altitude aircraft in support of NASA earth science research. 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 mm).

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.

MODIS Airborne Simulator

The MODIS Airborne Simulator (MAS) is a modified Daedalus multispectral scanner configured to replicate the capabilities of the Moderate-Resolution Imaging Spectrometer (MODIS), an instrument to be orbited on an EOS platform. MODIS is designed for the measurement of biological and physical processes and atmospheric temperature sounding. The MODIS Airborne Simulator records fifty 16-bit channels of multispectral data and is configured as follows:

Spectral Channel	Band center (µm)	Bandwidth (µm)	Spectral Range
1	0.4649	0.0397	0.4451-0.4848
2	0.5494	0.0417	0.5285-0.5703
3	0.6550	0.0511	0.6294-0.6805
4	0.7024	0.0415	0.6816-0.7231
5	0.7431	0.0420	0.7221-0.7641
6	0.8248	0.0427	0.8034-0.8461
7	0.8667	0.0414	0.8460-0.8874
8	0.9072	0.0409	0.8867-0.9276
9	0.9476	0.0397	0.9277-0.9674
10	1.6422	0.0519	1.6163-1.6682
11	1.6975	0.0505	1.6722-1.7228
12	1.7499	0.0506	1.7245-1.7752
13	1.8014	0.0491	1.7768-1.8259
14	1.8548	0.0489	1.8303-1.8792
15	1.9044	0.0487	1.8801-1.9288
16	1.9553	0.0483	1.9312-1.9794
17	2.0048	0.0487	1.9804-2.0291
18	2.0551	0.0484	2.0309-2.0793
19	2.1037	0.0486	2.0794-2.1280
20	2.1532	0.0483	2.1291-2.1774
21	2.2019	0.0481	2.1779-2.2259
22	2.2522	0.0486	2.2278-2.2675
23	2.3021	0.0487	2.2777-2.3265
24	2.3512	0.0476	2.3274-2.3750
25	2.4005	0.0483	2.3764-2.4246

Spectral Channel	Band center (µm)	Bandwidth (µm)	Spectral Range
26	3.1192	0.1616	3.0384-3.2000
27	3.2809	0.1486	3.2066-3.3552
28	3.4330	0.1617	3.3521-3.5138
29	3.5940	0.1539	3.5170-3.6709
30	3.7449	0.1449	3.6724-3.8174
31	3.9069	0.1602	3.8267-3.9870
32	4.0707	0.1554	3.9929-4.1484
33	4.1699	0.0669	4.1365-4.2034
34	4.4029	0.1255	4.3401-4.4656
35	4.5404	0.1512	4.4648-4.6160
36	4.6979	0.1591	4.6184-4.7775
37	4.8536	0.1516	4.7778-4.9294
38	5.0033	0.1468	4.9298-5.0767
39	5.1588	0.1400	5.0888-5.2288
40	5.3075	0.1327	5.2412-5.3738
41	5.3977	0.0755	5.3590-5.4365
42	8.5366	0.3950	8.3391-8.7341
43	9.7224	0.5365	9.4541-9.9906
44	10.5071	0.4579	10.278-10.736
45	11.0119	0.4710	10.776-11.247
46	11.9863	0.4196	11.776-12.196
47	12.9013	0.3763	12.713-13.089
48	13.2702	0.4584	13.041-13.500
49	13.8075	0.5347	13.540-14.075
50	14.2395	0.3775	14.051-14.428

NOTE: Bandpass centers approximate

Sensor/Aircraft Parameters:

Spectral Bands:	50 (digitized to 16-bit resolution)
IFOV:	2.5 mrad
Ground Resolution:	163 feet (50 meter at 65,000 feet)
Swath Width:	22.9 mi/19.9 nmi (36 km)
Total Scan Angle:	85.92^{o}
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.)

MIT Millimeter-wave Temperature Sounder

The Millimeter-wave Temperature Sounder (MTS) is a dual-band microwave radiometer system for the measurement of atmospheric temperature and other phenomena affecting transmission in the microwave absorption bands of molecular oxygen. MTS data has been used to produce images of temperature and precipitation structure, to infer precipitation cell top altitudes and to detect atmospheric waves.

The instrument is capable of either downward- or upward-viewing operation on the ER-2 as well as ground-based operation. One radiometer is an eight channel scanning spectrometer with its radiometer centered on the 118,75 GHz oxygen line. The second radiometer is a single-channel (Ch. 0) nadir (or zenith) viewing system with its local oscillator tunable under computer control from 52 to 54 GHz. Characteristics of the two radiometers are as follows:

Channel	Center freq. (MHz)	Width (MHz)
	Single Channel Radiometer	
0	115	170

Channel	Center freq. (MHz)	Width (MHz)
	Eight Channel Radiometer	
1	660	170
2	840	210
3	1040	240
4	1260	220
5	1470	240
6	1670	220
7	1900	270
8	500	125

For further information contact Michael Schwarz, Massachusetts Institute of Technology, MIT-RLE Mail Stop 26-357, 77 Massachusetts Ave., Cambridge, MA 02139.

NPOESS Aircraft Sounder Testbed - (NAST-I)

The National Polar-orbiting Operational Environmental Satellite System (NPOESS) Atmospheric Sounding Testbed (NAST) is a suite of airborne infrared and microwave spectrometers, being developed for the Integrated Program Office (IPO), that are being flown on the NASA high altitude ER-2 aircraft as part of the risk reduction effort for NPOESS. In addition to their stand-alone scientific value, data from these airborne instruments will be used to simulate possible satellite-based radiance measurements, therefore enabling experimental validation of instrument system specifications and data processing techniques for future advanced atmospheric remote sensors (e.g., the proposed sounder component for NPOESS).

The NAST-I is a high resolution Michelson interferometer, developed by MIT Lincoln Laboratory, that derives its heritage from the non-scanning High resolution Interferometer Sounder (HIS) developed by researchers at the University of Wisconsin and serves as a critical component of the NAST instrument suite. It will scan the Earth beneath the ER-2 with a nominal spatial resolution of approximately 2.5 km with 13 Earth view observations in the cross-track direction (resulting in a cross-track swath width of about 45 km), with an unapodized spectral resolution of 0.25 cm-1 within the 3.6 - 17 micron (590 - 2810 cm-1) spectral range. The NAST-I instrument flies in the superpod of NASA's high altitude ER-2 aircraft. Its infrared radiance observations will provide information on the spectral characteristics of the atmosphere and surface, enabling detailed retrievals of atmospheric

temperature and water vapor profiles at high temporal and spatial resolution. Specific science products will consist of direct and derived quantities associated with the measured infrared radiance spectra. Direct products will include brightness temperatures for discrete wavelength intervals sensitive to variations in the desired geophysical parameters, i.e., surface temperature, and atmospheric temperature and water vapor. Derived products will include surface temperature, atmospheric temperature and water vapor content representative of different atmospheric vertical layers, cloud top pressure and thermodynamic state, as well as tropospheric trace gas concentrations.

NAST-I measurements obtained during the CAMEX-3 field experiment will be available from the project's data archive; most products will be in both an image format (i.e., GIF) for quick-look browsing and a digital format (i.e. NetCDF) suitable for further data analysis.

NAST-I Point of Contact:
Bill Smith, NASA Langley Research Center, Mail Stop 401, Hampton, VA 23681-2199
Office Telephone: (757) 864-5914
FAX: (757) 864-8197
E-mail: bill.l.smith@larc.nasa.gov The NAST-I Homepage: http://cimss.ssec.wisc.edu/nast.

High-Resolution Interferometer Sounder

The High-Resolution Interferometer Sounder (HIS) measures upwelling infrared spectral radiance at the aircraft altitude with high absolute accuracy using a passive Michelson interferometer and precision onboard blackbody calibration sources. The instrument has a single nadir staring field of view with observed spectra obtained every six seconds. The spectra cover the range 16.6 microns to 3.3 microns with a spectral resolution of 0.3 to 0.5 cm-1. The primary use of the instrument is as an atmospheric sounder of temperature and water vapor. The spectra also contain important information on trace gases and surface properties. The HIS was developed by the University of Wisconsin at Madison and is a prototype instrument for advanced infrared satellite sounders.

Flight Documentation and Data Archive Searches

The following is the web site for flight documentation as published by the Airborne Sensor Facility at NASA Ames Research Center: http://asapdata.arc.nasa.gov/er-2fsr.html

Additional information regarding flight documentation to include data archive searches, data availability, sensor parameters, and areas of coverage may be obtained from the following:

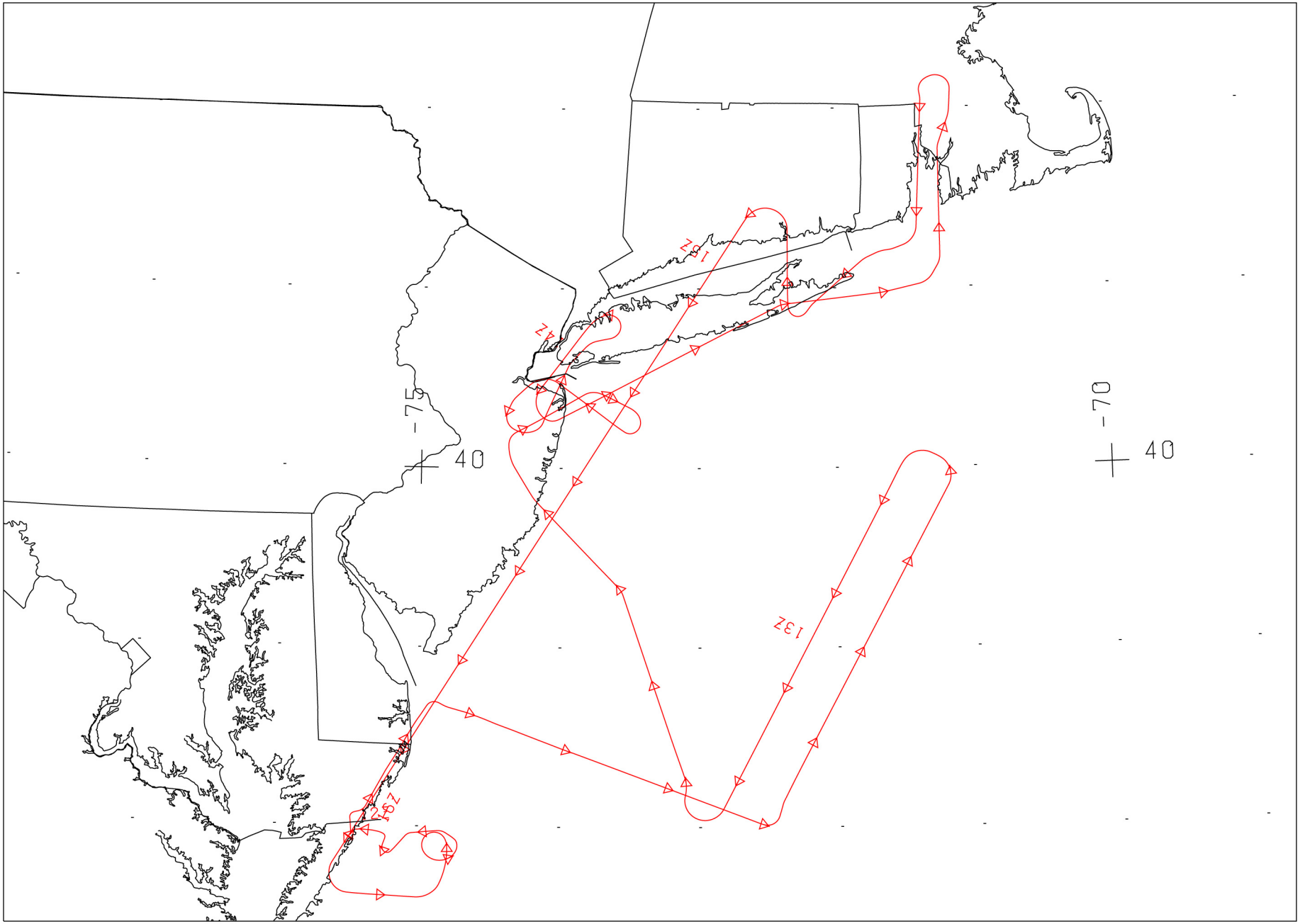
Airborne Sensor Facility
MS 240-6
NASA Ames Research Center
Moffett Field, CA 94035-1000
Telephone: (650)604-6252 (FAX 4987)

CAMERA FLIGHT LINE DATA
FLIGHT NO. 98-086

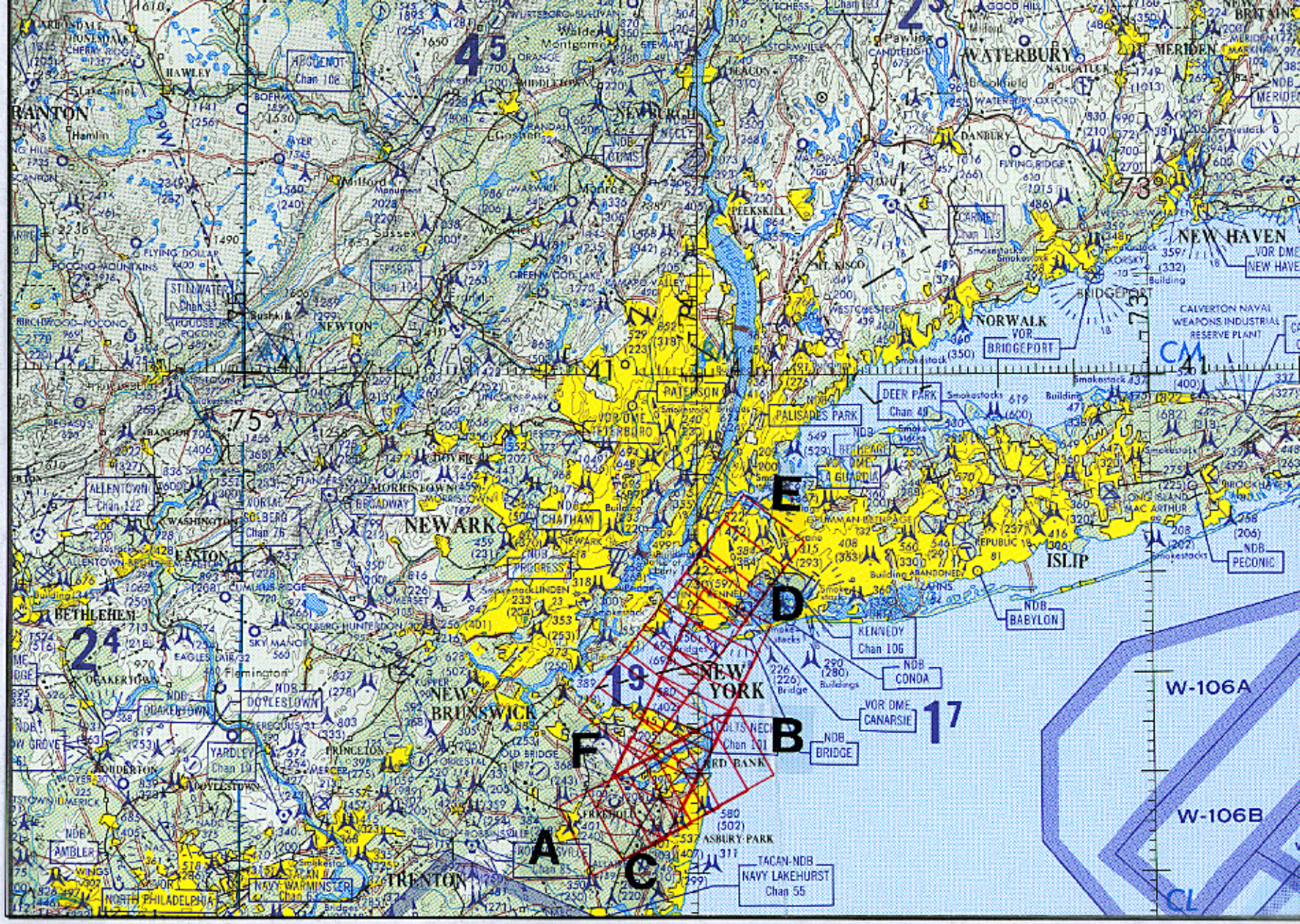
Accession # 05266

Sensor # 034

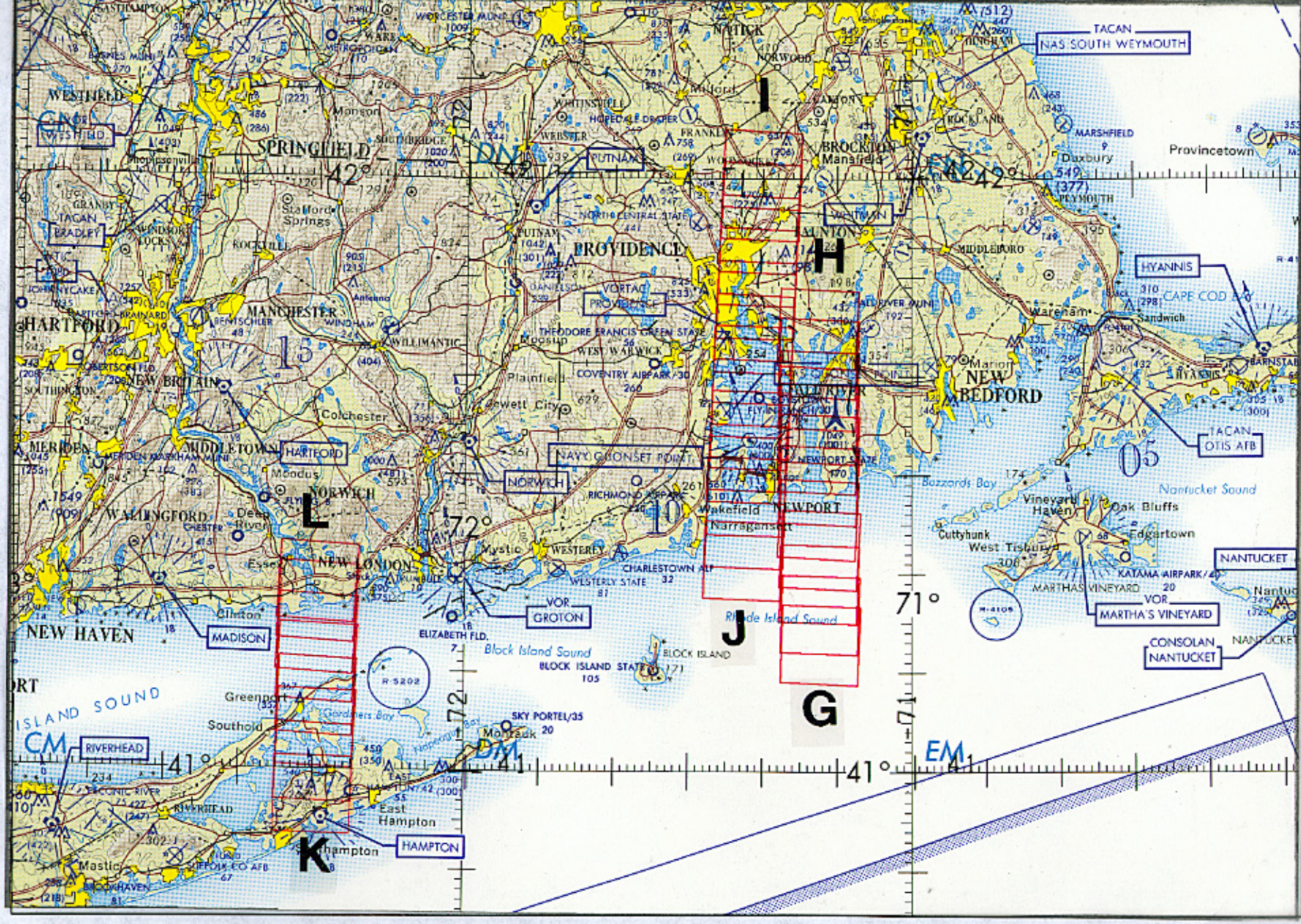
Check Points	Frame Numbers	Time (GMT-hr, min, sec) START	Time (GMT-hr, min, sec) END	Altitude, MSL feet/meters	Cloud Cover/Remarks
A - B	7353-7357	13:33:28	13:35:22	68420/20854	Clear
C - D	7358-7363	13:51:00	13:53:22	68067/20747	Clear
E - F	7364-7370	13:59:47	14:02:37	68043/20740	Clear
G - H	7371-7381	14:26:40	14:31:23	69209/21095	Clear
I - J	7382-7394	14:37:29	14:43:10	68992/21029	Minor cumulus (frames 7383-7388)
K - L	7395-7402	14:51:57	14:55:04	68838/20982	10% cumulus (frames 7400-7402)
M - N	7403-7414	15:28:12	15:33:24	70000/21336	10% cumulus (frames 7403-7409)



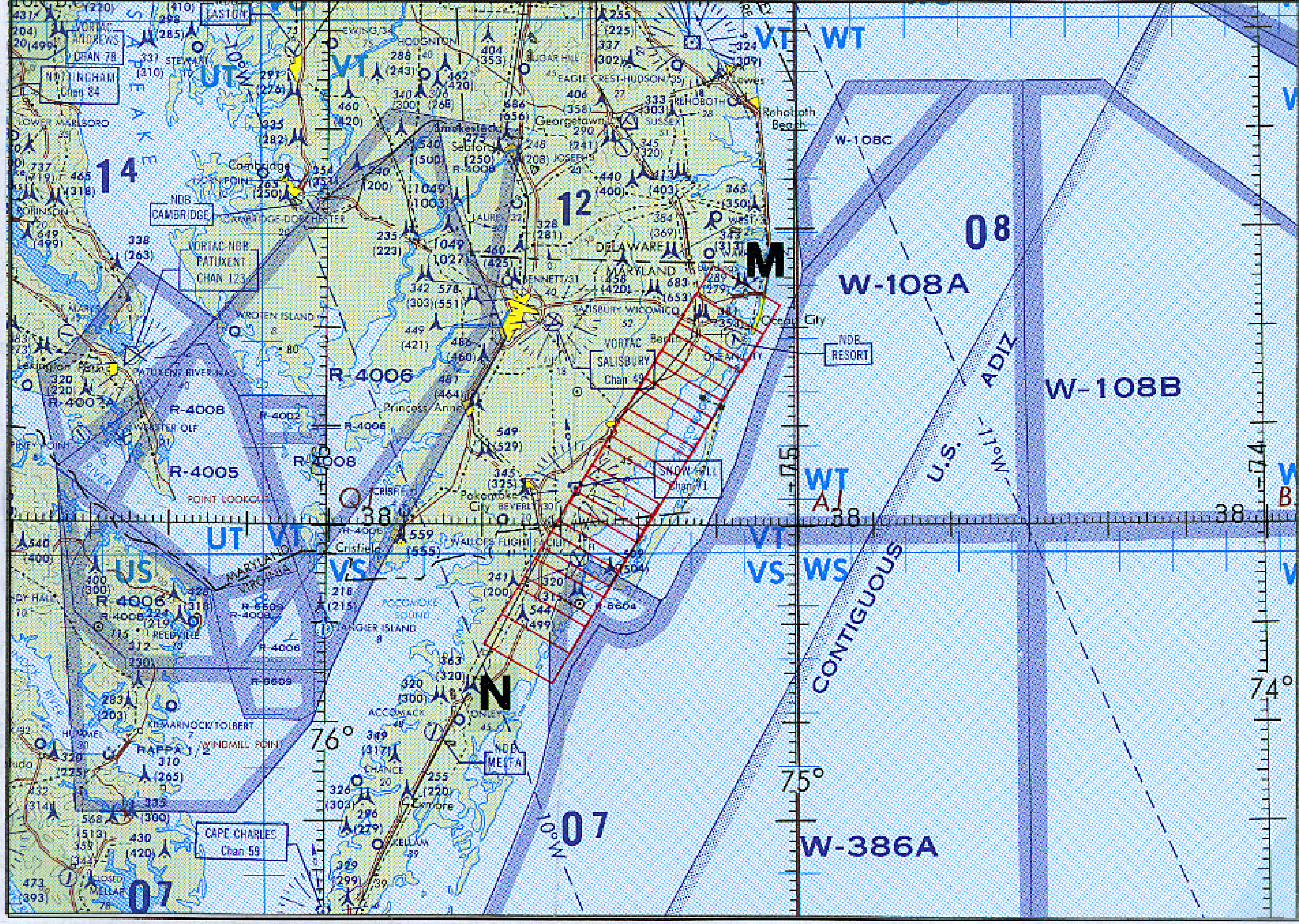
FLIGHT 98-086 11 JULY 1998 A/C 809 RC-10 / AVIRIS / NAST-I / HIS / MAS-50



FLIGHT 98-086 11 JULY 1998 A/C 809 RC-10 / AVIRIS ONC F-19



FLIGHT 98-086 11 JULY 1998 A/C 809 RC-10 / AVIRIS ONC F-19



FLIGHT 98-086 11 JULY 1998 A/C 809 RC-10 / AVIRIS ONC G-21