

Convection And Moisture EXperiment (CAMEX)

The Convection And Moisture EXperiment (CAMEX) is a series of field research investigations sponsored by Dr. Ramesh Kakar, Program Manager for Atmospheric Dynamics and Remote Sensing at the National Aeronautics and Space Administration (NASA) Headquarters. The overall goal of CAMEX is to study atmospheric water vapor and precipitation processes using a unique array of aircraft, balloon, and land-based remote sensors. The first two CAMEX field studies were conducted at Wallops Island, Virginia, during 1993 and 1995.

The third in the series of CAMEX field studies (CAMEX-3) was based at Patrick Air Force Base, Florida from 6 August-23 September 1998. The field campaign was devoted to the study of hurricane tracking and intensification using NASA-funded aircraft remote instrumentation. The NASA ER-2 and DC-8 were the primary aircraft platforms employed for the deployment. Additional aircraft were provided through collaboration with the National Weather Service/Tropical Prediction Center/National Hurricane Center and National Oceanic and Atmospheric Administration/Hurricane Research Division. As a result actual mission sorties involved as many as five to six aircraft.

CAMEX-3 successfully studied Hurricanes Bonnie, Danielle, Earl and Georges. The campaign collected data for research in tropical cyclone development, tracking, intensification, and landfalling impacts. This study will yield high spatial and temporal information of hurricane structure, dynamics, and motion.

The remote sensing instrumentation utilized by NASA during CAMEX-3 yields high spatial and temporal information of hurricane structure, dynamics, and motion. These data, when analyzed within the context of more traditional aircraft, satellite, and ground-based radar observations, should provide additional insight to hurricane modelers and forecasters who continually strive to improve hurricane predictions. The ultimate goal of CAMEX-3 is to provide information which could someday assist in decreasing the size of coastal evacuation areas and increasing the warning time for those areas.

(The above summary was extracted from the CAMEX web page at the following URL: http://ghrc.msfc.nasa.gov/camex3/mission_desc)

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.

Multispectral Atmospheric Mapping Sensor

The Multispectral Atmospheric Mapping Sensor (MAMS) is a modified Daedalus Scanner flown aboard the ER-2 aircraft. It is designed to study weather related phenomena including storm system structure, cloud-top temperatures, and upper atmosphere water vapor. The scanner retains the eight silicon-detector channels in the visible/near-infrared region found on the Daedalus Thematic Mapper Simulator, with the addition of four channels in the infrared relating to specific atmospheric features. The spectral bands are as follows:

<u>Daedalus Channel</u>	<u>Wavelength, mm</u>
1	LSBs for Channels 9-12
2	0.45 - 0.52
3	0.52 - 0.60
4	0.57 - 0.67
5	0.60 - 0.73
6	0.65 - 0.83
7	0.72 - 0.99
8	0.83 - 1.05
9	6.20 - 6.90 optional
10	6.20 - 6.90 optional
11	10.3 - 12.1
12	12.5 - 12.8

Spatial Resolution: 50 meters from 19.8 km (65,000 ft.)
Total Field of View: 85.92 degrees
IFOV: 2.5 mrad

Notes: Channels 9-12 are digitized to 10-bits; all others are 8-bit. Blackbody sources are carried for IR calibration.

MAMS data will not be archived at EROS Data Center because this is an experimental system with low spatial resolution and unique spectral characteristics. As all scenes will be primarily cloud-covered there would be little terrestrial application for the data. Further information concerning the data can be obtained from principal investigator, Gregory S. Wilson, Atmospheric Effects Branch, George C. Marshall Space Flight Center, National Aeronautics and Space Administration, Marshall Space Flight Center, Alabama 35812-5001.

Data Availability

The U.S. Geological Survey's EROS Data Center at Sioux Falls, South Dakota serves as the archive and product distribution facility for Airborne Science Program aircraft acquired photographic and digital imagery. The photographic archive consists of photography acquired by the program from 1971 to April 1996. 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).

As of April 1996 the EROS Data Center no longer receives an archive copy of newly acquired Airborne Science Program photography. Original photography is archived with the Airborne Sensor Facility at Ames Research Center. A user copy of the photography is provided to the

principal investigators for each flight. Principal investigators are cited on the first page of their respective flight summary reports. For information regarding photography acquired from April 1996 to the present contact the Airborne Sensor Facility as follows:

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)

Convection And Moisture EXperiment (CAMEX)

98-105	5 August	Ferry - Dryden to Patrick AFB
98-106	8 August	Florida Coast
98-107	13 August	Cape Canaveral
98-108	15 August	Florida Coast
98-109	23 August	Florida Coast
98-110	24 August	Hurricane Bonnie
98-111	26 August	Hurricane Bonnie (landfall)
98-112	29 August	Florida Coast
98-113	30 August	Hurricane Danielle
98-114	2 September	Hurricane Earl (Gulf of Mexico)
98-115	5 September	Florida Coast
98-116	8 September	Central Florida
98-117	13 September	Andros Island
98-118	17 September	Florida Coast (Gulf of Mexico)
98-119	21 September	Hurricane Georges (Virgin Islands)
98-120	22 September	Hurricane Georges (Hispanola)
98-132	23 September	Ferry - Patrick AFB to Warner Robbins AFB
98-136	25 September	Hurricane Georges (South Florida - Keys)
98-137	27 September	Hurricane Georges (Gulf Coast)
98-138	28 September	Ferry - Warner Robbins AFB to Dryden

FLIGHT SUMMARY REPORT

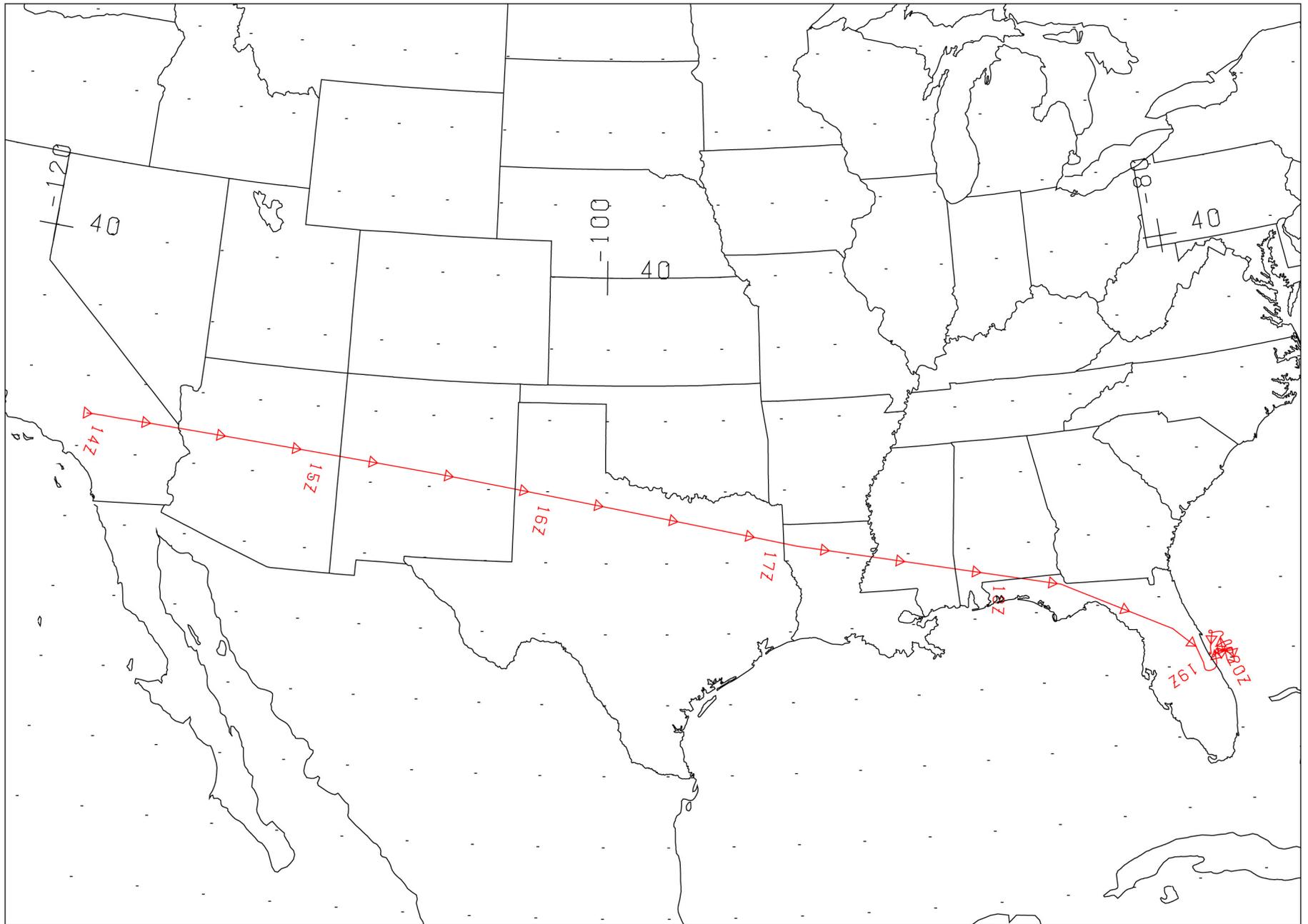
Flight Number: 98-105
Calendar/Julian Date: 05 August 1998 • 217
Sensor Package: Multispectral Atmospheric Mapping
Sensor (MAMS)
Area(s) Covered: Ferry (Dryden to Patrick AFB)
(CAMEX III)

Investigator(s): Hood and Guillory, MSFC

Aircraft #: 806

SENSOR DATA

Accession #: ----
Sensor ID #: 102
Sensor Type: MAMS
Focal Length: ----
Film Type: ----
Filtration: ----
Spectral Band: ----
f Stop: ----
Shutter Speed: ----
of Frames: ----
% Overlap: ----
Quality: ----
Remarks:

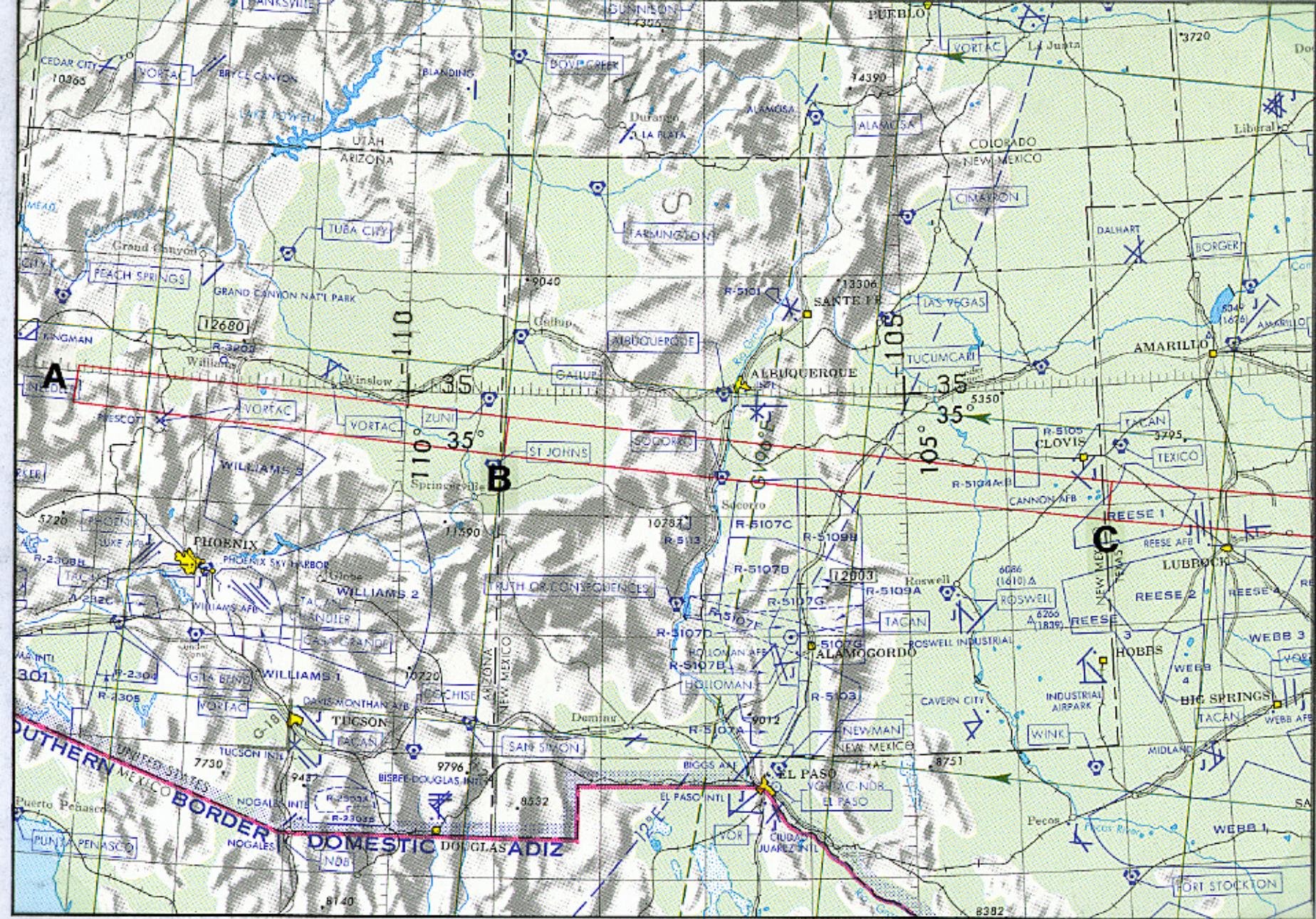


FLIGHT 98-105

5 AUGUST 1998

A/C 806

CAMEX III



FLIGHT 98-105

5 AUGUST 1998

A/C 806

MAMS

GNC 2



FLIGHT 98-105

5 AUGUST 1998

A/C 806

MAMS

GNC 2



FLIGHT 98-105

5 AUGUST 1998

A/C 806

MAMS

GNC 2

FLIGHT SUMMARY REPORT

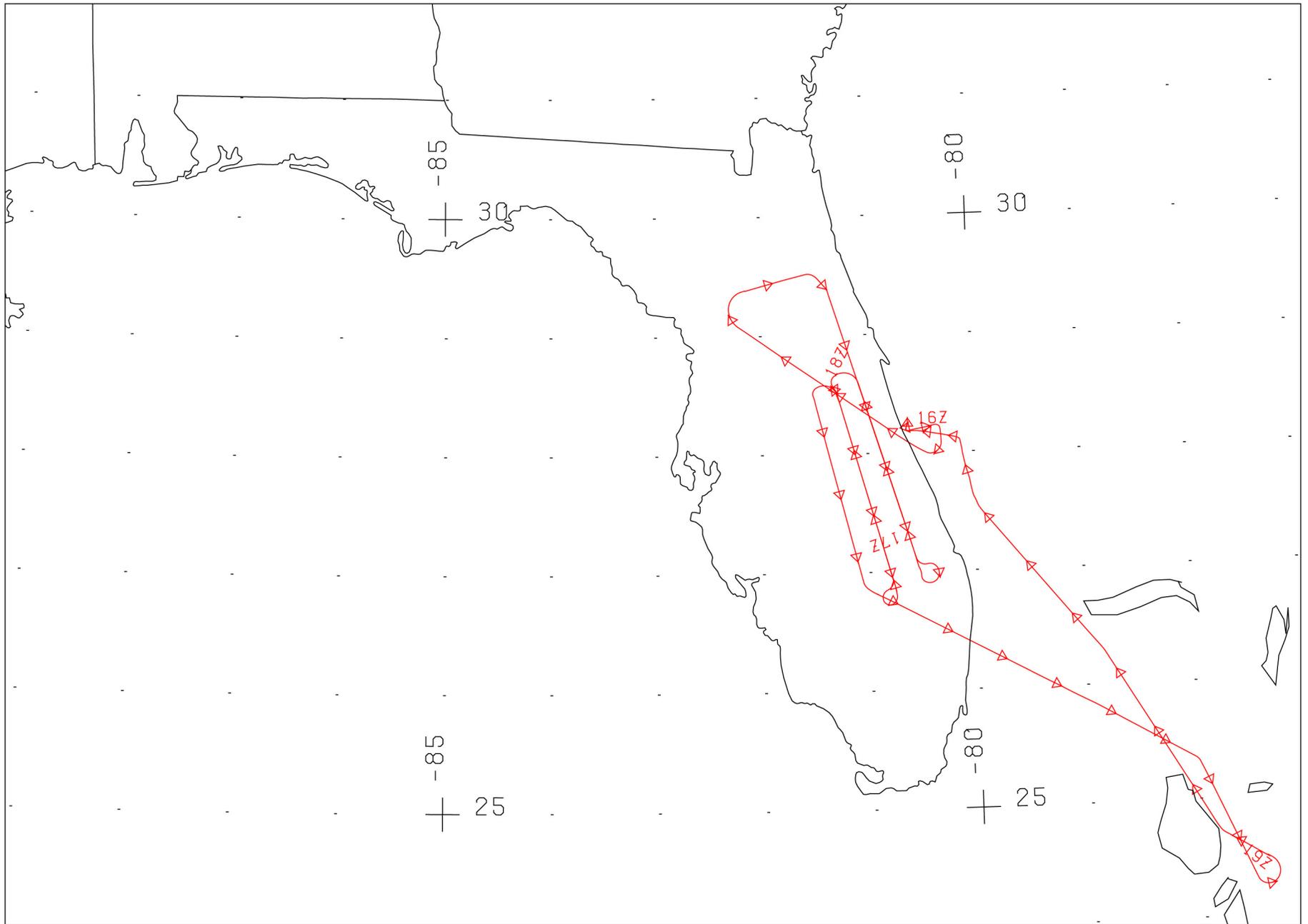
Flight Number: 98-106
Calendar/Julian Date: 08 August 1998 • 220
Sensor Package: Multispectral Atmospheric Mapping
Sensor (MAMS)
Area(s) Covered: Florida Coast (CAMEX III)

Investigator(s): Hood and Guillory, MSFC

Aircraft #: 806

SENSOR DATA

Accession #: ----
Sensor ID #: 102
Sensor Type: MAMS
Focal Length: ----
Film Type: ----
Filtration: ----
Spectral Band: ----
f Stop: ----
Shutter Speed: ----
of Frames: ----
% Overlap: ----
Quality: ----
Remarks:



FLIGHT 98-106

8 AUGUST 1998

A/ 806

CAMEX



FLIGHT SUMMARY REPORT

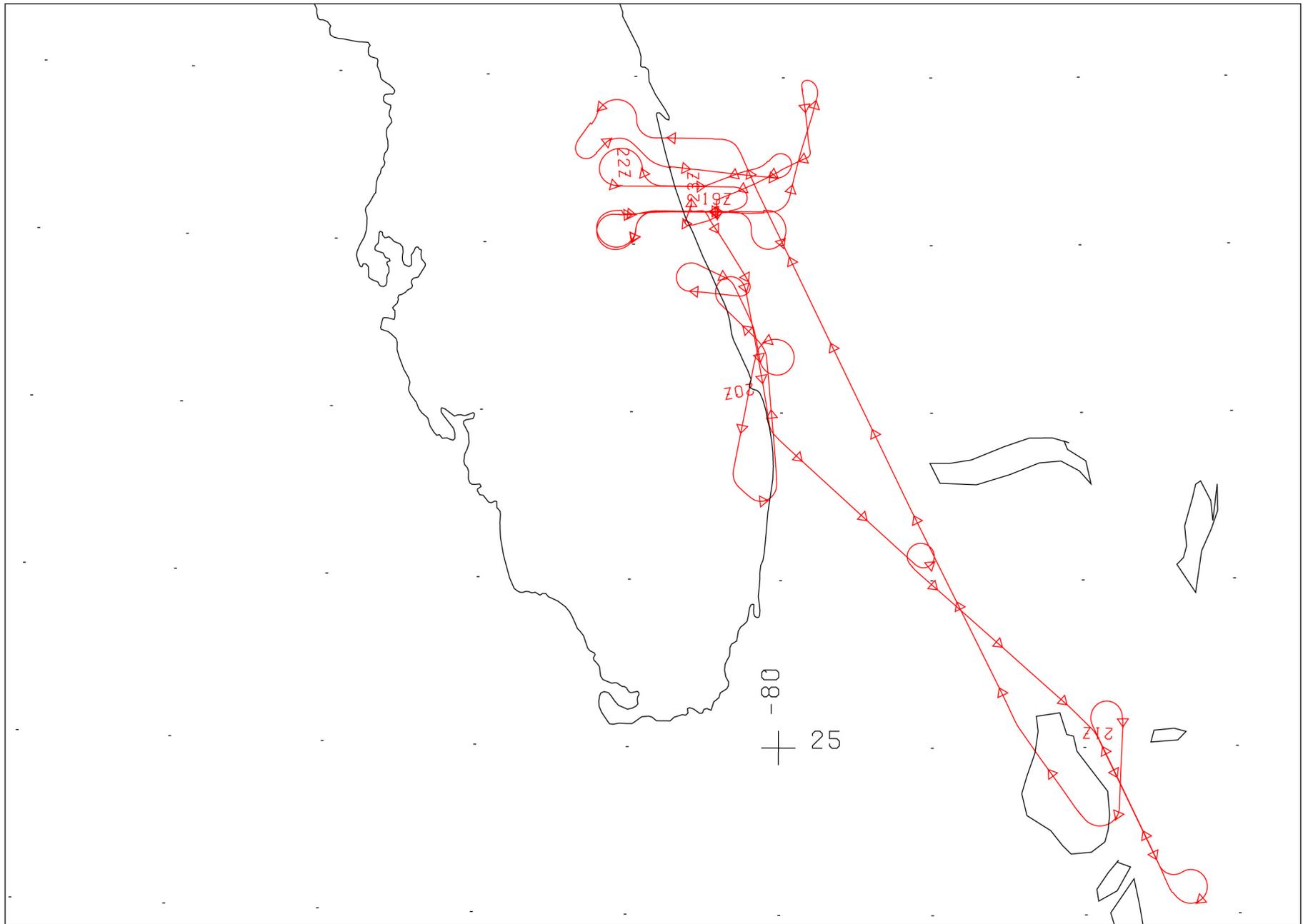
Flight Number: 98-107
Calendar/Julian Date: 13 August 1998 • 225
Sensor Package: Multispectral Atmospheric Mapping
Sensor (MAMS)
Area(s) Covered: Florida Coast (CAMEX III)

Investigator(s): Hood and Guillory, MSFC

Aircraft #: 806

SENSOR DATA

Accession #: ----
Sensor ID #: 102
Sensor Type: MAMS
Focal Length: ----
Film Type: ----
Filtration: ----
Spectral Band: ----
f Stop: ----
Shutter Speed: ----
of Frames: ----
% Overlap: ----
Quality: ----
Remarks:

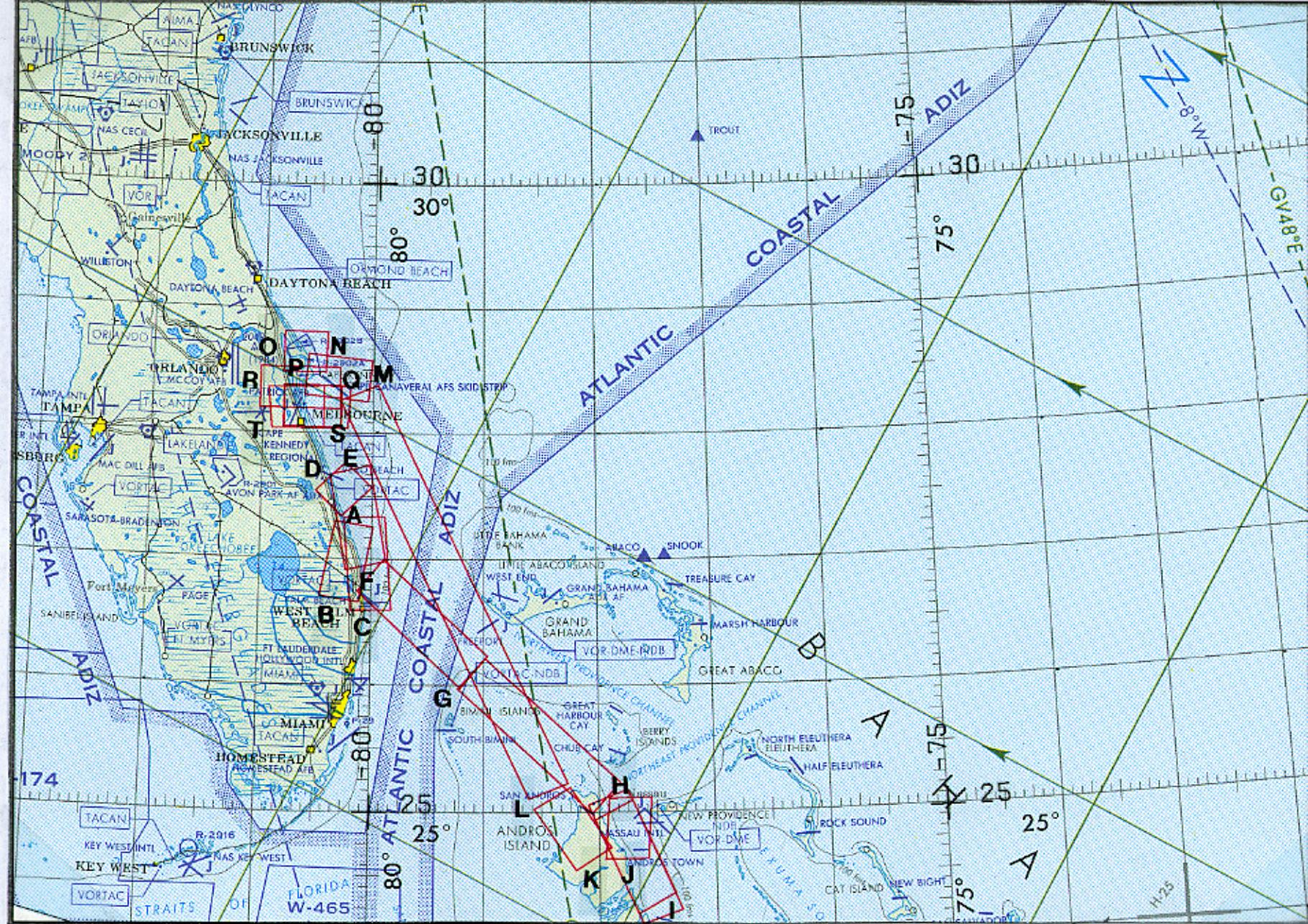


FLIGHT 98-107

13 AUGUST 1998

A/C 806

CAMEX III



FLIGHT 98-107

13 AUGUST 1998

R/C 806

MAMS

GNC 2

FLIGHT SUMMARY REPORT

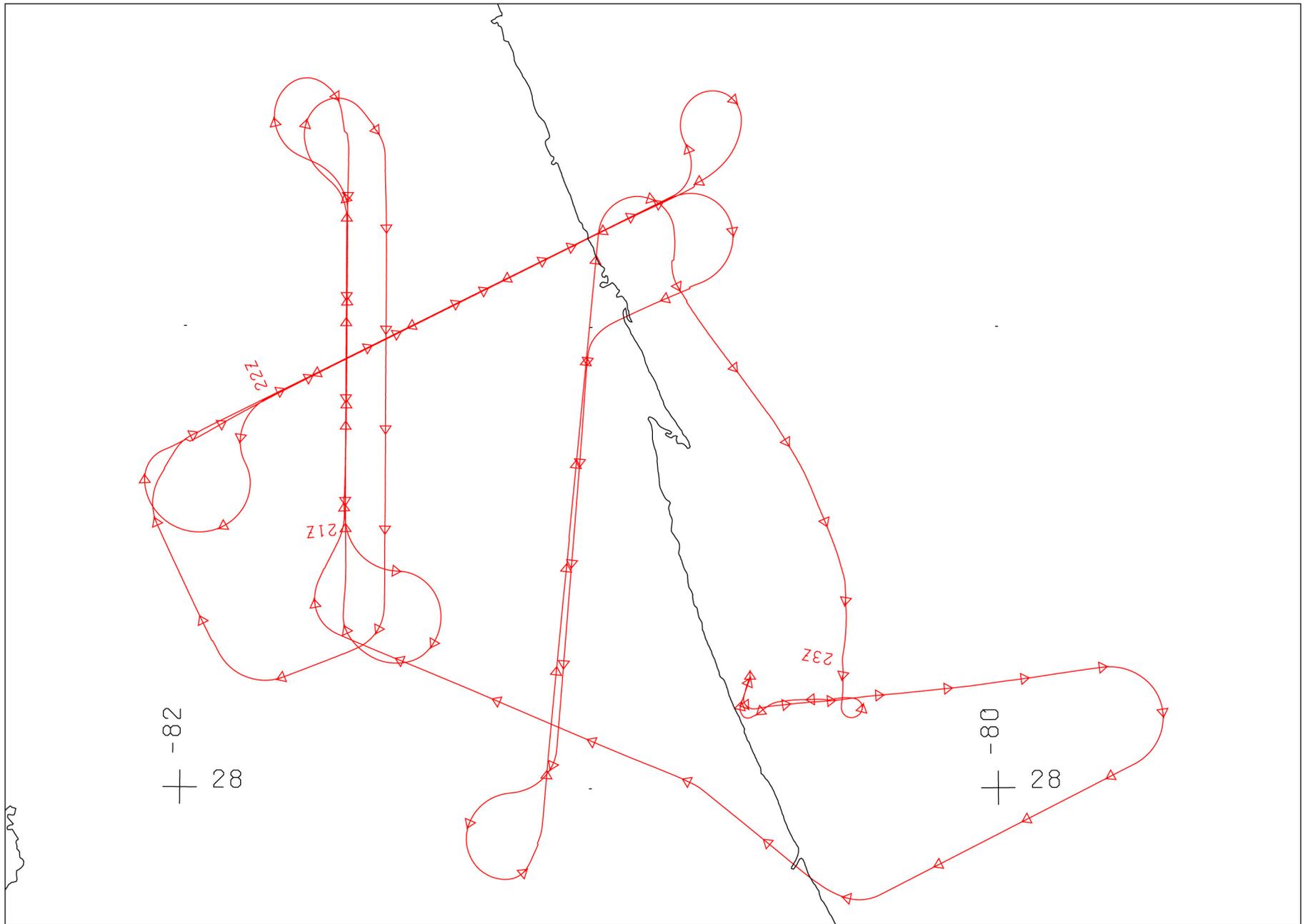
Flight Number: 98-108
Calendar/Julian Date: 15 August 1998 • 227
Sensor Package: Multispectral Atmospheric Mapping
Sensor (MAMS)
Area(s) Covered: Florida Coast (CAMEX III)

Investigator(s): Hood and Guillory, MSFC

Aircraft #: 806

SENSOR DATA

Accession #: ----
Sensor ID #: 102
Sensor Type: MAMS
Focal Length: ----
Film Type: ----
Filtration: ----
Spectral Band: ----
f Stop: ----
Shutter Speed: ----
of Frames: ----
% Overlap: ----
Quality: Good
Remarks:

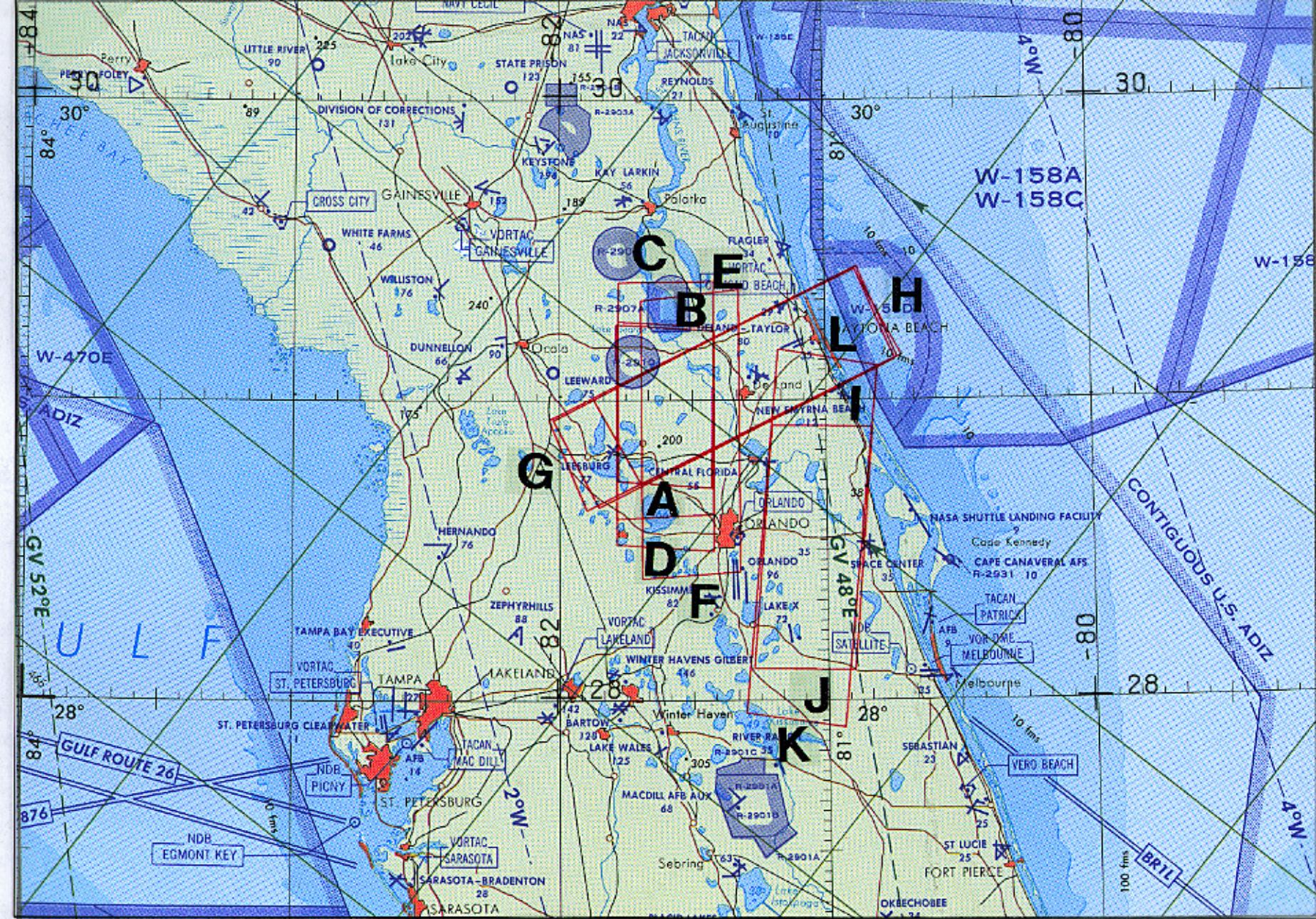


FLIGHT 98-108

15 AUGUST 1998

A/C 806

CAMEX III



FLIGHT 98-108 15 AUGUST 1998 A/C 806 MAMS JNC 45

FLIGHT SUMMARY REPORT

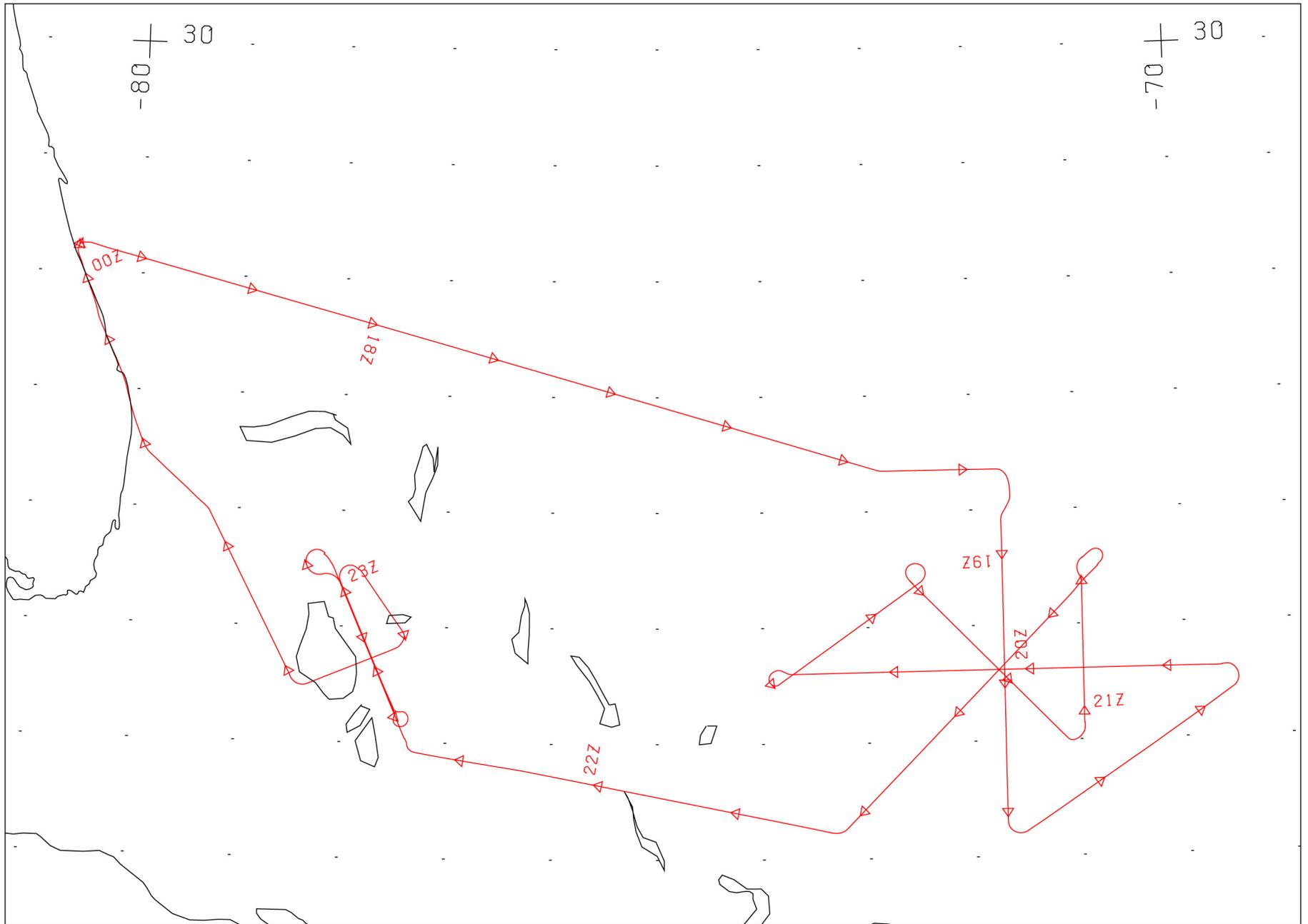
Flight Number: 98-109
Calendar/Julian Date: 23 August 1998 • 235
Sensor Package: Multispectral Atmospheric Mapping
Sensor (MAMS)
Area(s) Covered: Florida Coast (CAMEX III)

Investigator(s): Hood and Guillory, MSFC

Aircraft #: 806

SENSOR DATA

Accession #: ----
Sensor ID #: 102
Sensor Type: MAMS
Focal Length: ----
Film Type: ----
Filtration: ----
Spectral Band: ----
f Stop: ----
Shutter Speed: ----
of Frames: ----
% Overlap: ----
Quality: Good
Remarks:



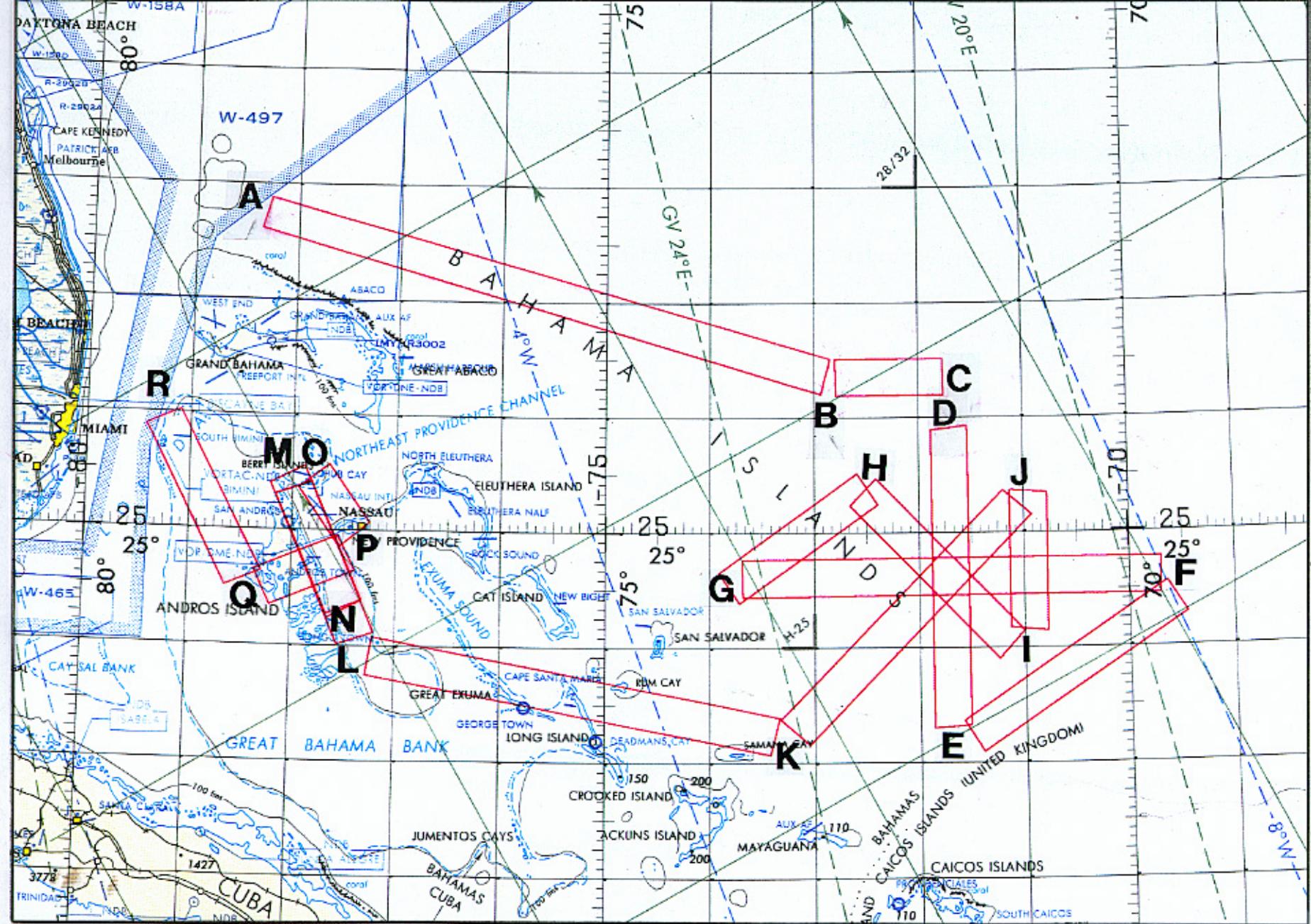
FLIGHT 98-109

23 AUGUST 1998

A/C 806

CAMEX III

HURRICANE BONNIE OVER-FLIGHT



FLIGHT 98-109

23 AUGUST 1998

A/C 806

MMS

GNC 9

FLIGHT SUMMARY REPORT

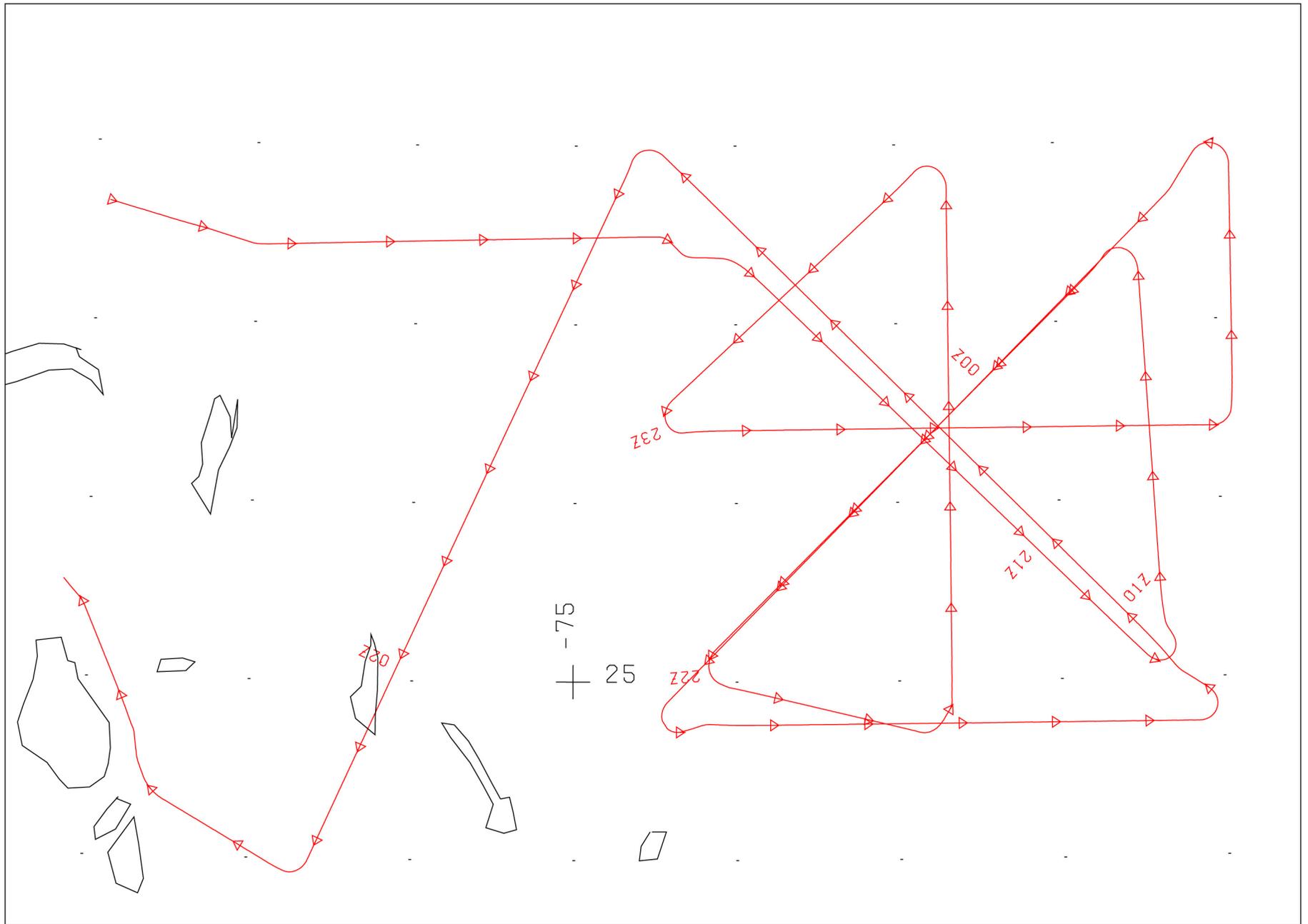
Flight Number: 98-110
Calendar/Julian Date: 24-25 August 1998 • 236-237
Sensor Package: Multispectral Atmospheric Mapping
Sensor (MAMS)
Area(s) Covered: Hurricane Bonnie (CAMEX III)

Investigator(s): Hood and Guillory, MSFC

Aircraft #: 806

SENSOR DATA

Accession #: ----
Sensor ID #: 102
Sensor Type: MAMS
Focal Length: ----
Film Type: ----
Filtration: ----
Spectral Band: ----
f Stop: ----
Shutter Speed: ----
of Frames: ----
% Overlap: ----
Quality: Good
Remarks:

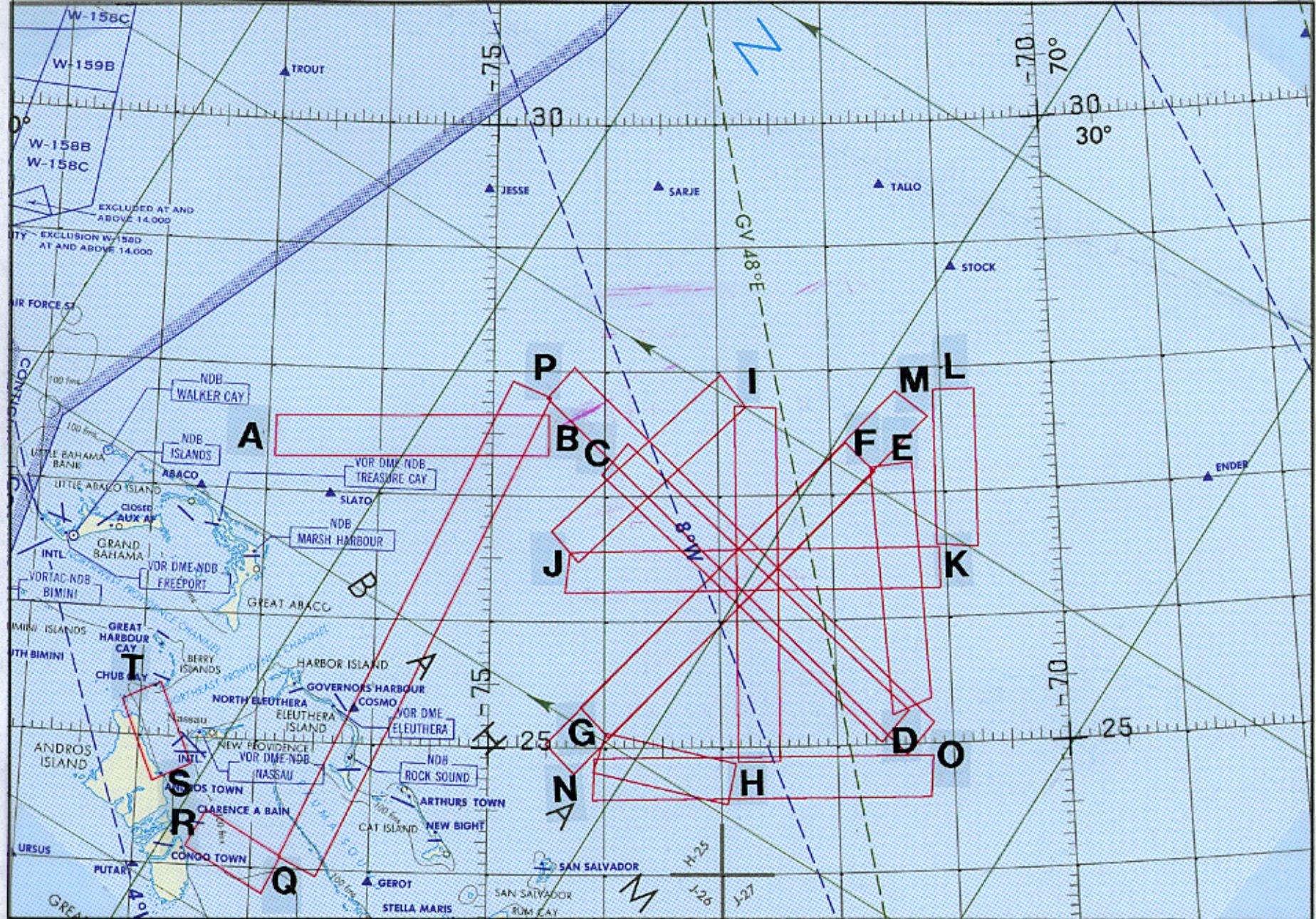


FLIGHT 98-110

24 AUGUST 1998

A/C 806

CAMEX III (HURRICANE BONNIE)



FLIGHT SUMMARY REPORT

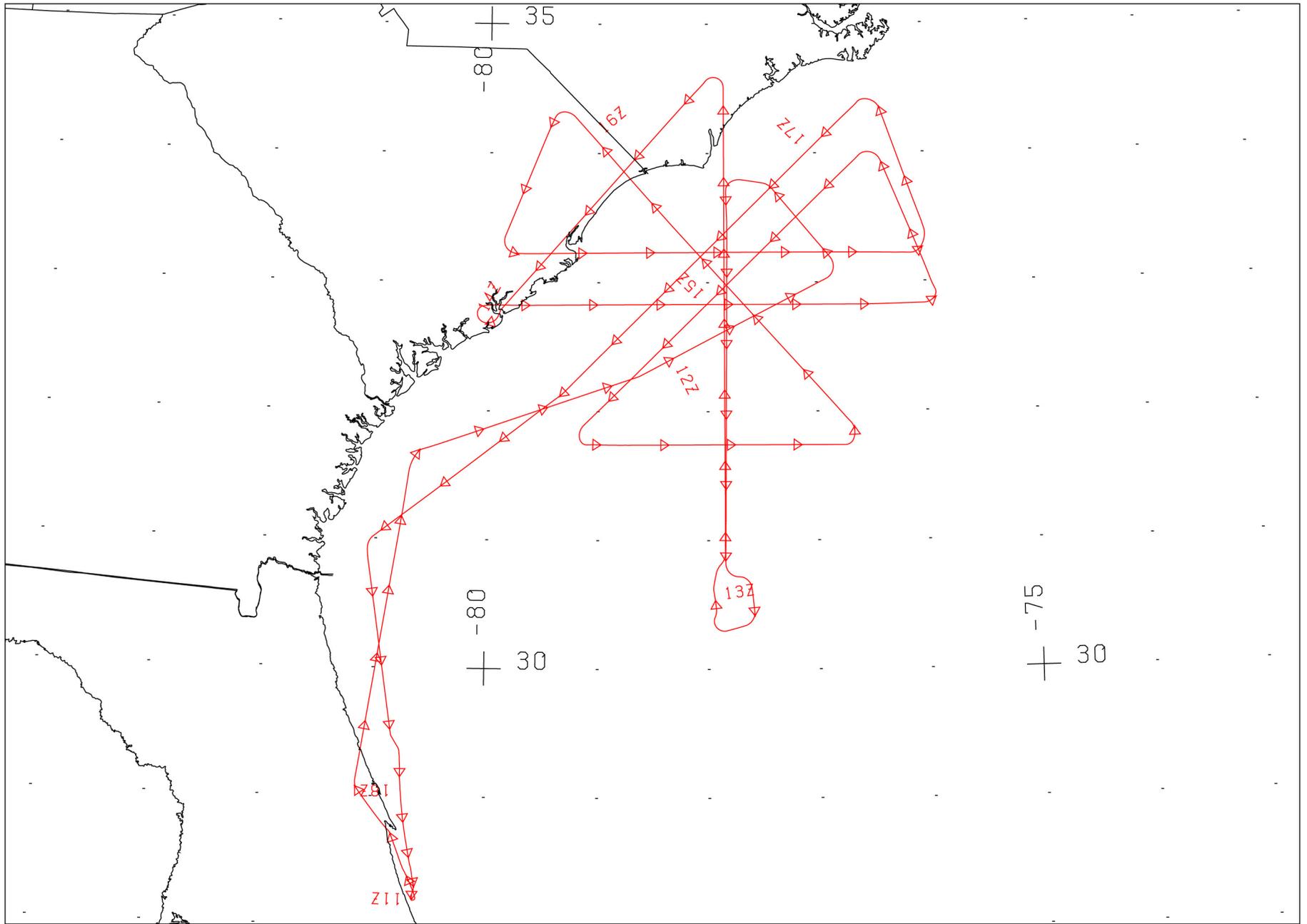
Flight Number: 98-111
Calendar/Julian Date: 26 August 1998 • 238
Sensor Package: Multispectral Atmospheric Mapping
Sensor (MAMS)
Area(s) Covered: Hurricane Bonnie (landfall) (CAMEX III)

Investigator(s): Hood and Guillory, MSFC

Aircraft #: 806

SENSOR DATA

Accession #: ----
Sensor ID #: 102
Sensor Type: MAMS
Focal Length: ----
Film Type: ----
Filtration: ----
Spectral Band: ----
f Stop: ----
Shutter Speed: ----
of Frames: ----
% Overlap: ----
Quality: Good
Remarks:



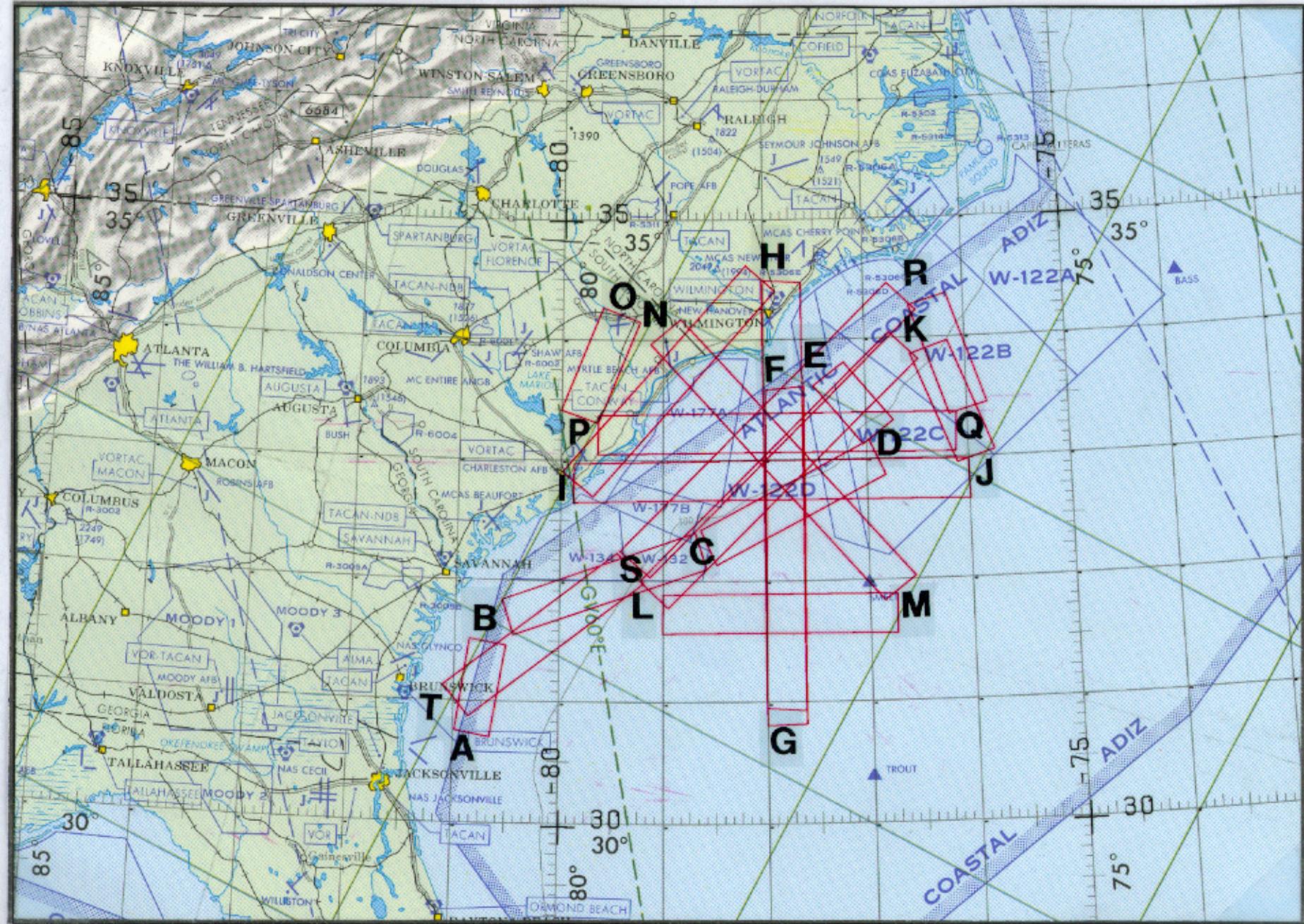
FLIGHT 98-111

26 AUGUST 1998

A/C 806

CAMEX-III

(HURRICANE BONNIE - LANDFALL)



FLIGHT 98-111

26 AUGUST 1998

A/C 806

MAMS

(HURRICANE BONNIE)

GNC 2

FLIGHT SUMMARY REPORT

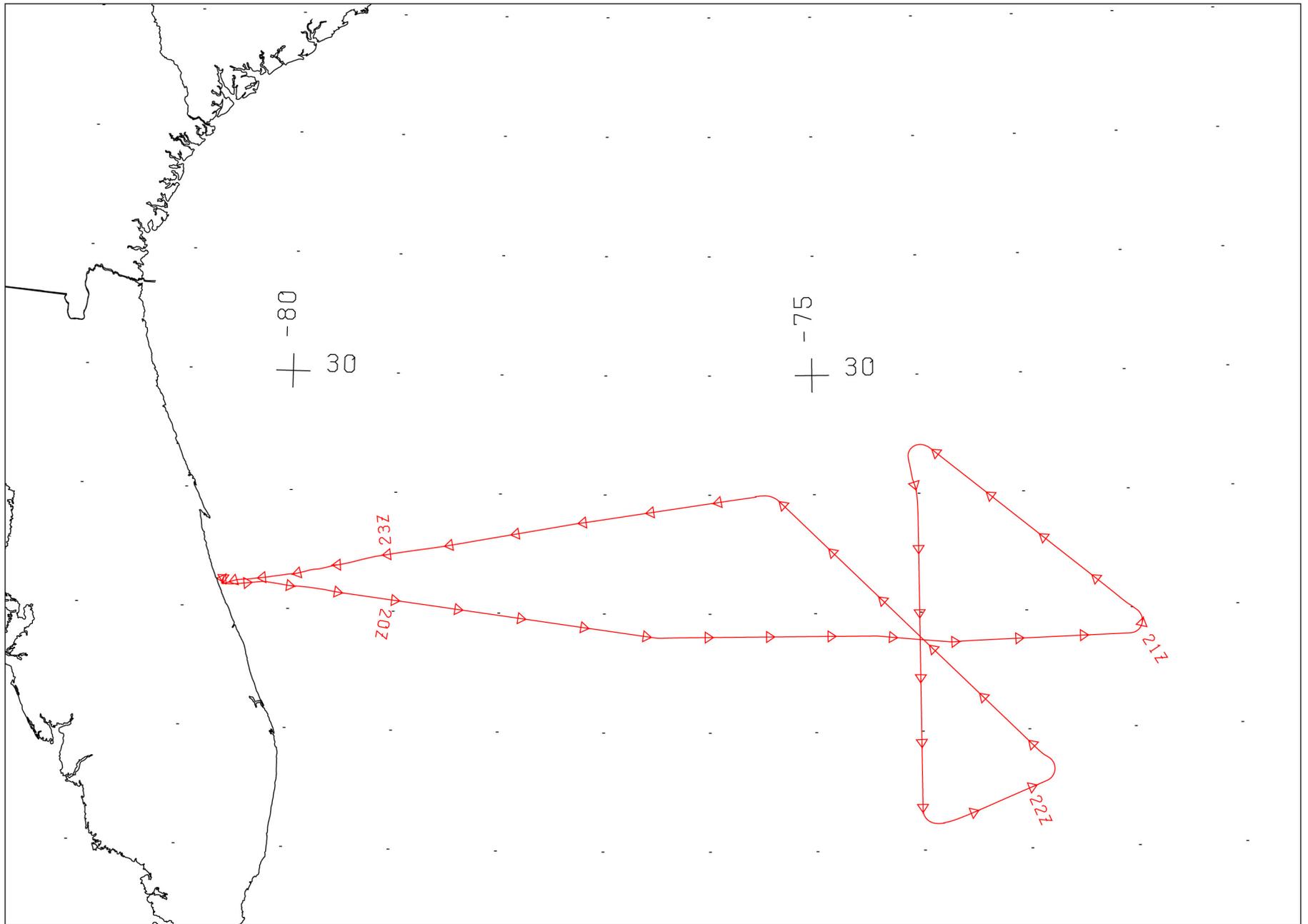
Flight Number: 98-113
Calendar/Julian Date: 30 August 1998 • 242
Sensor Package: Multispectral Atmospheric Mapping
Sensor (MAMS)
Area(s) Covered: Hurricane Danielle (CAMEX III)

Investigator(s): Hood and Guillory, MSFC

Aircraft #: 806

SENSOR DATA

Accession #: ----
Sensor ID #: 102
Sensor Type: MAMS
Focal Length: ----
Film Type: ----
Filtration: ----
Spectral Band: ----
f Stop: ----
Shutter Speed: ----
of Frames: ----
% Overlap: ----
Quality: Good
Remarks:



FLIGHT 98-113

30 AUGUST 1998

A/C 806

CAMEX III

(HURRICANE DANIELLE)

FLIGHT SUMMARY REPORT

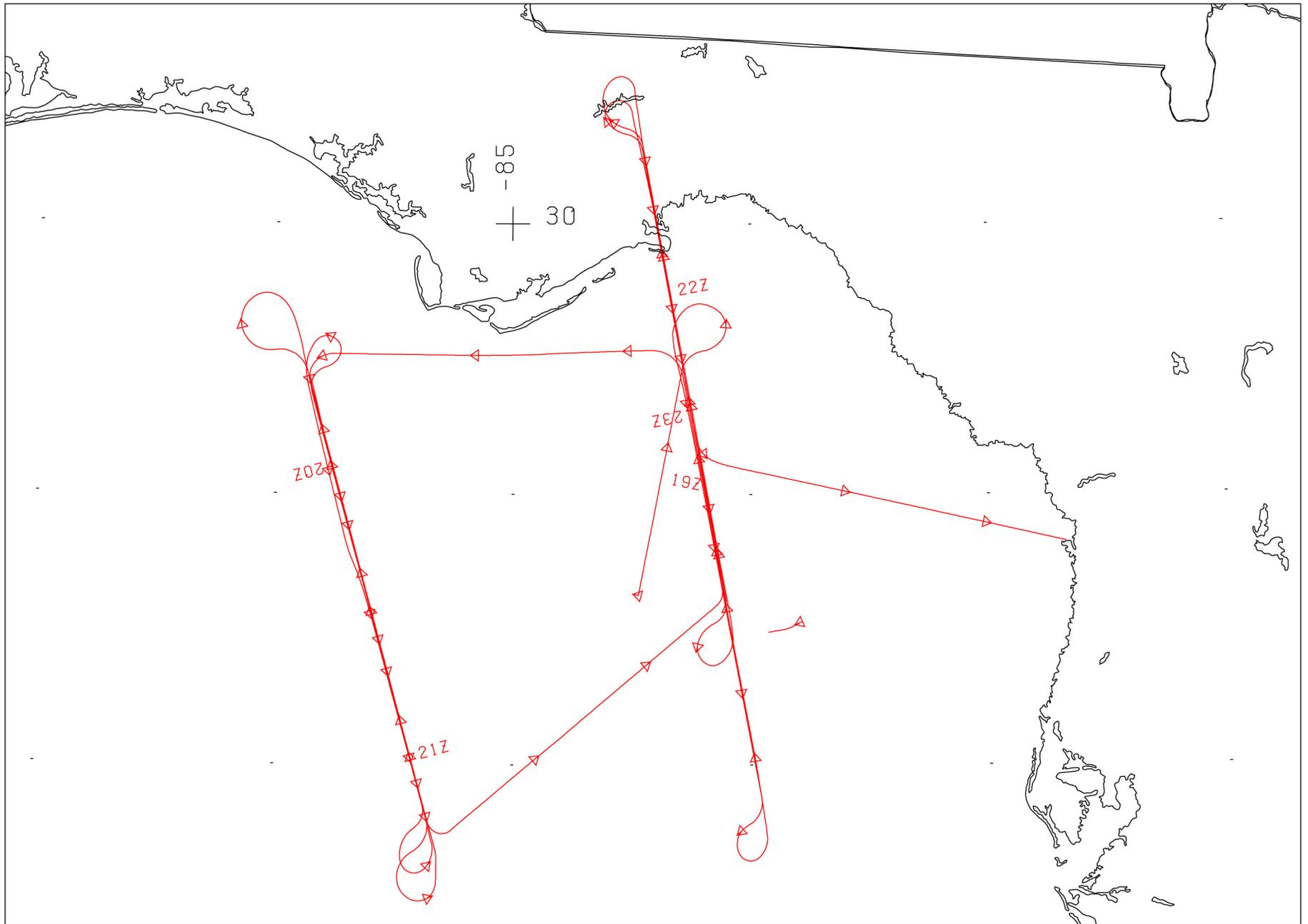
Flight Number: 98-114
Calendar/Julian Date: 2 September 1998 • 245
Sensor Package: Multispectral Atmospheric Mapping
Sensor (MAMS)
Area(s) Covered: Hurricane Earl - Gulf of Mexico (CAMEX III)

Investigator(s): Hood and Guillory, MSFC

Aircraft #: 806

SENSOR DATA

Accession #: ----
Sensor ID #: 102
Sensor Type: MAMS
Focal Length: ----
Film Type: ----
Filtration: ----
Spectral Band: ----
f Stop: ----
Shutter Speed: ----
of Frames: ----
% Overlap: ----
Quality: Good
Remarks:



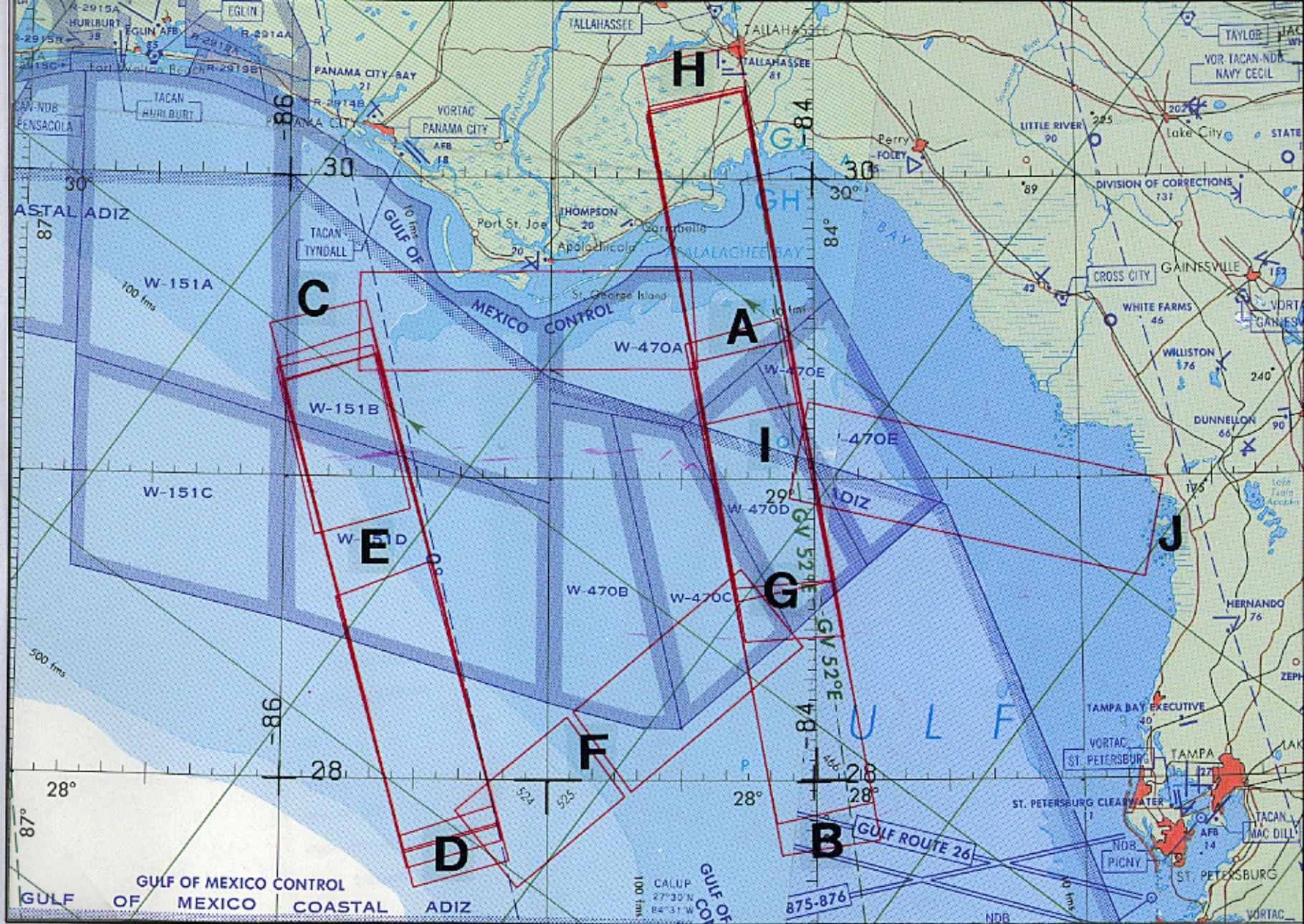
FLIGHT 98-114

2 SEPTEMBER 1998

A/C 806

CAMEX III

(HURRICANE EARL)



FLIGHT SUMMARY REPORT

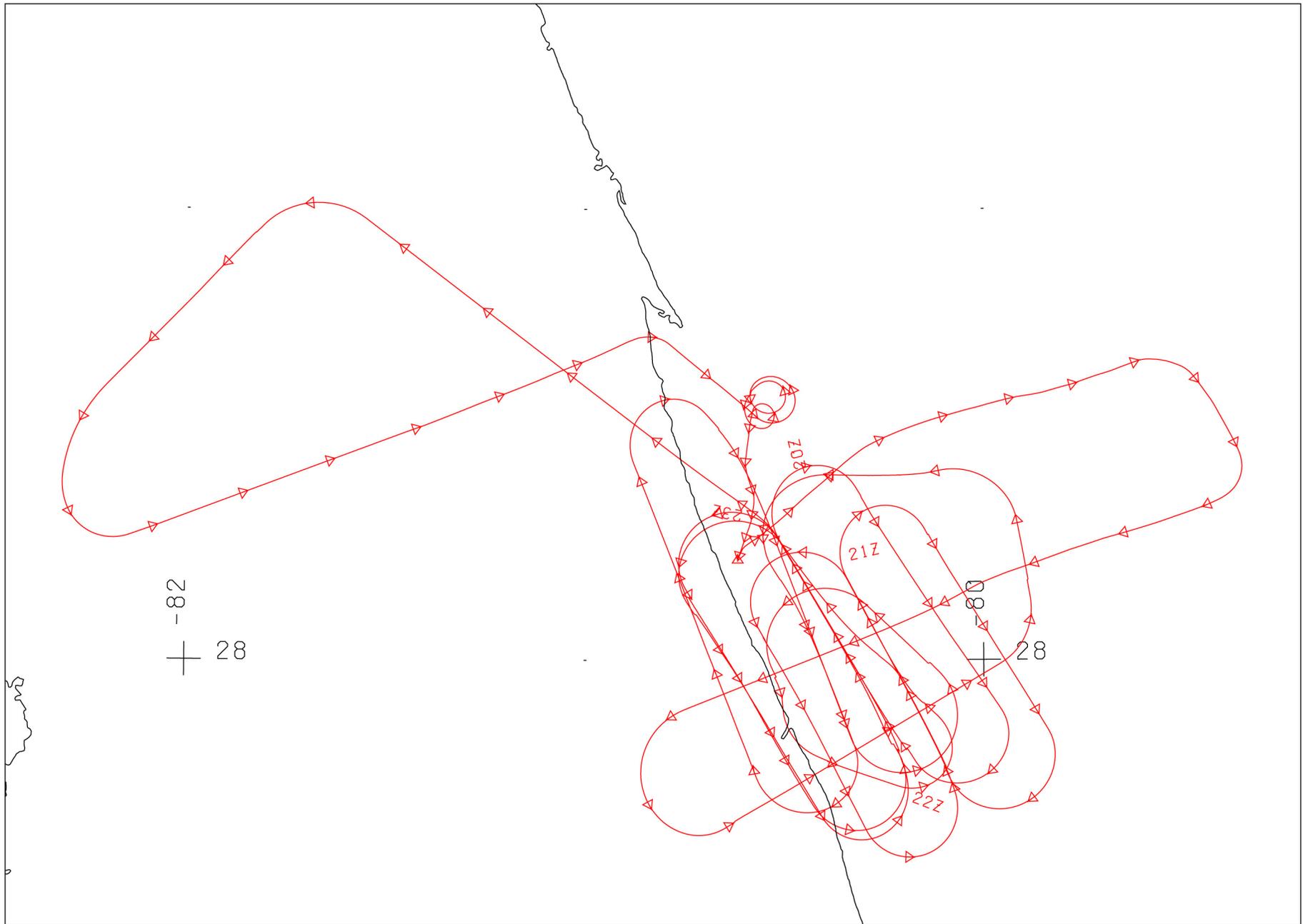
Flight Number: 98-115
Calendar/Julian Date: 5 September 1998 • 248
Sensor Package: Multispectral Atmospheric Mapping
Sensor (MAMS)
Area(s) Covered: Florida Coast (CAMEX III)

Investigator(s): Hood and Guillory, MSFC

Aircraft #: 806

SENSOR DATA

Accession #: ----
Sensor ID #: 102
Sensor Type: MAMS
Focal Length: ----
Film Type: ----
Filtration: ----
Spectral Band: ----
f Stop: ----
Shutter Speed: ----
of Frames: ----
% Overlap: ----
Quality: Good
Remarks:



FLIGHT 98-115

5 SEPTEMBER 1998

A/C 806

CAMEX III

FLIGHT SUMMARY REPORT

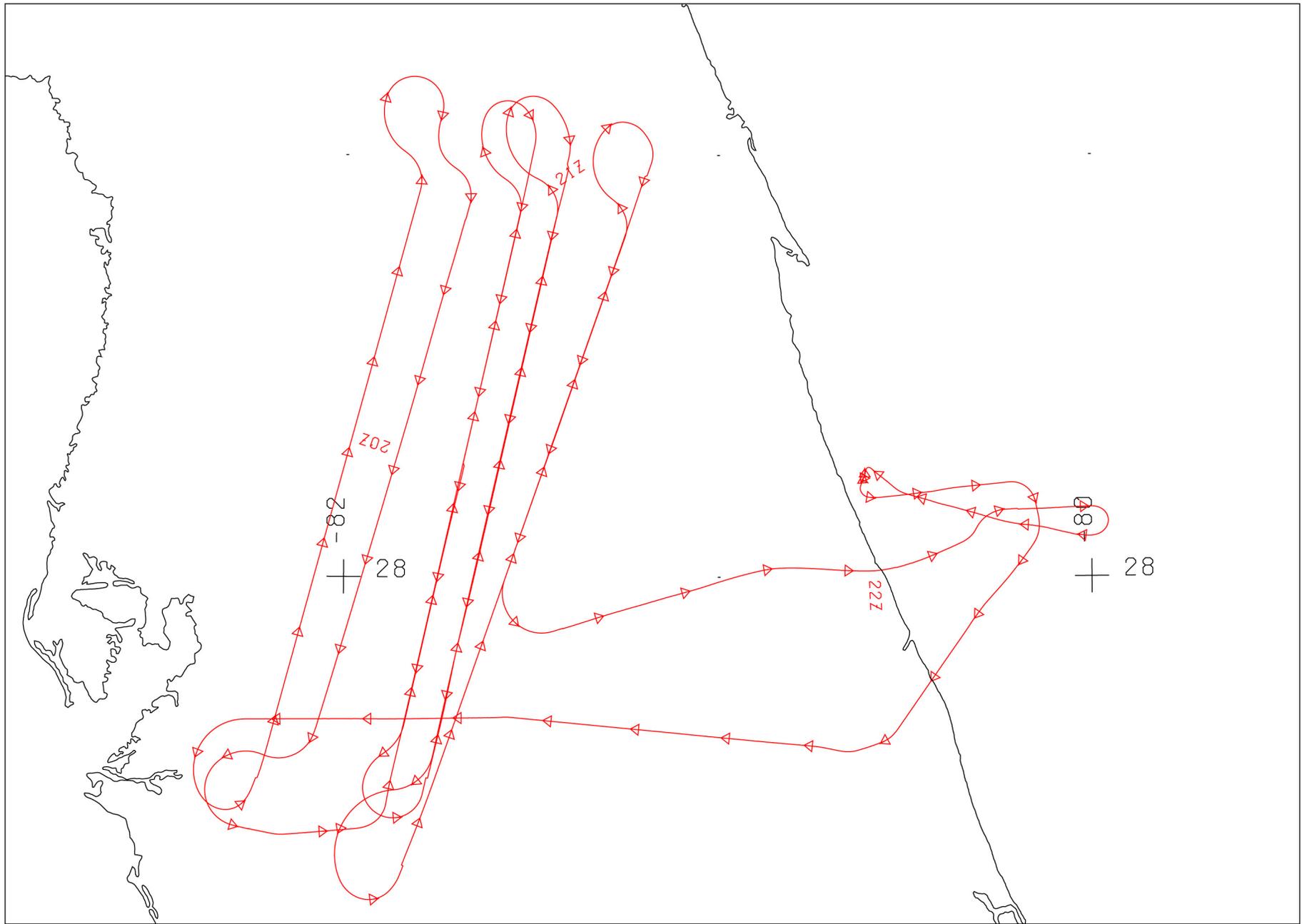
Flight Number: 98-116
Calendar/Julian Date: 8 September 1998 • 251
Sensor Package: Multispectral Atmospheric Mapping
Sensor (MAMS)
Area(s) Covered: Central Florida (CAMEX III)

Investigator(s): Hood and Guillory, MSFC

Aircraft #: 806

SENSOR DATA

Accession #: ----
Sensor ID #: 102
Sensor Type: MAMS
Focal Length: ----
Film Type: ----
Filtration: ----
Spectral Band: ----
f Stop: ----
Shutter Speed: ----
of Frames: ----
% Overlap: ----
Quality: Fair to Good
Remarks:

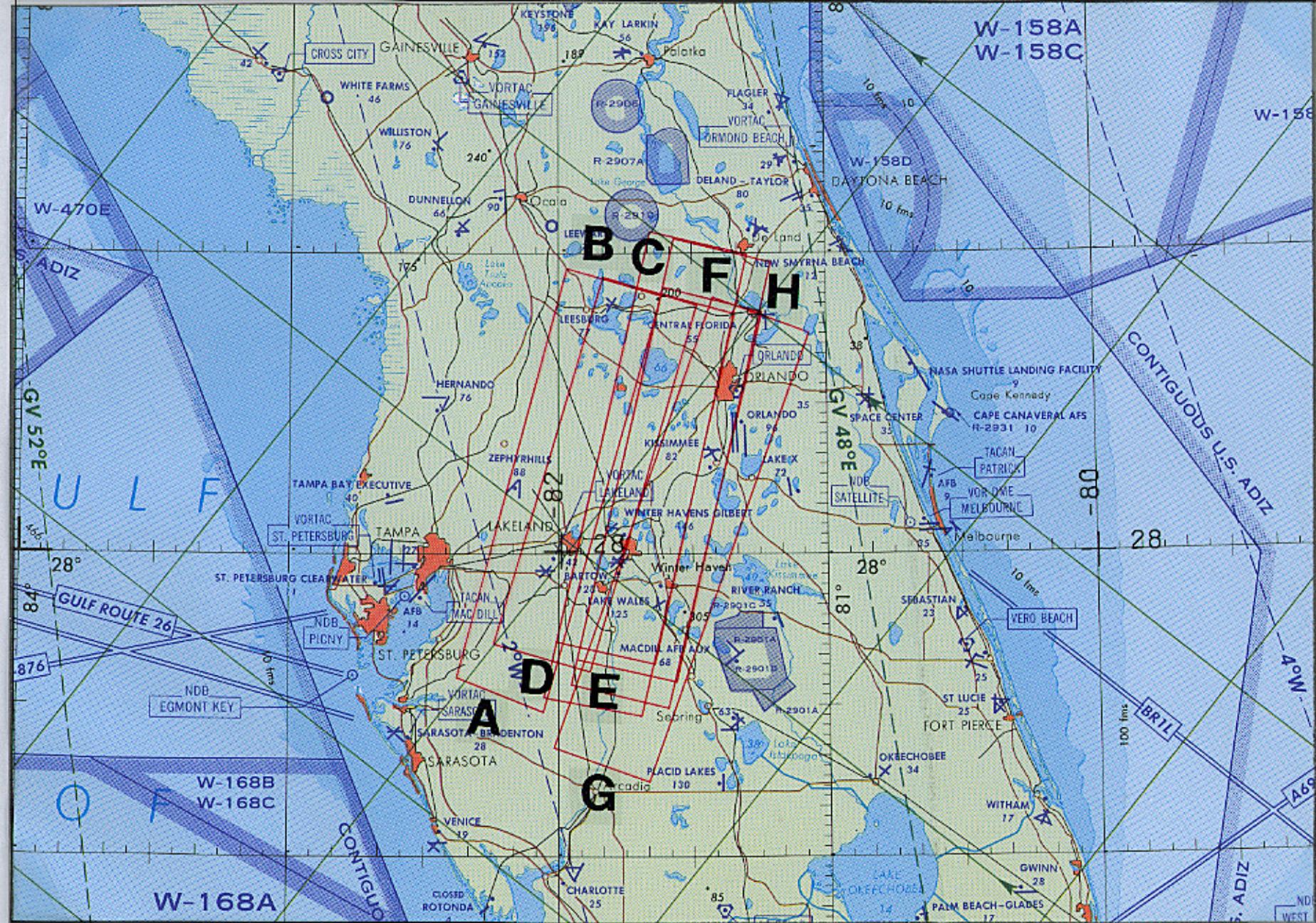


FLIGHT 98-116

8 SEPTEMBER 1998

A/C 806

CAMEX III



FLIGHT SUMMARY REPORT

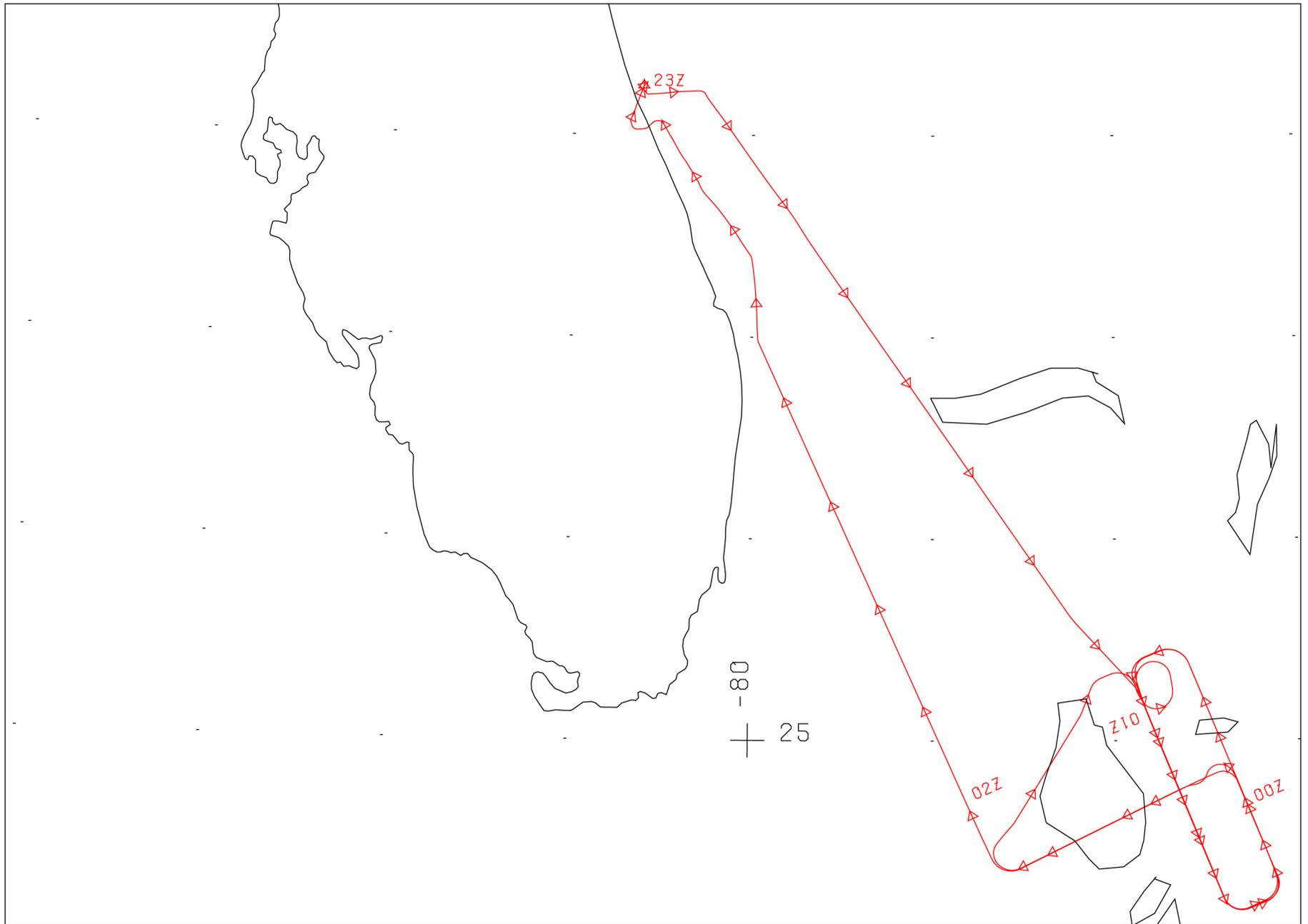
Flight Number: 98-117
Calendar/Julian Date: 13 September 1998 • 256
Sensor Package: Multispectral Atmospheric Mapping
Sensor (MAMS)
Area(s) Covered: Andros Island (CAMEX III)

Investigator(s): Hood and Guillory, MSFC

Aircraft #: 806

SENSOR DATA

Accession #: ----
Sensor ID #: 102
Sensor Type: MAMS
Focal Length: ----
Film Type: ----
Filtration: ----
Spectral Band: ----
f Stop: ----
Shutter Speed: ----
of Frames: ----
% Overlap: ----
Quality: Fair to Good
Remarks:

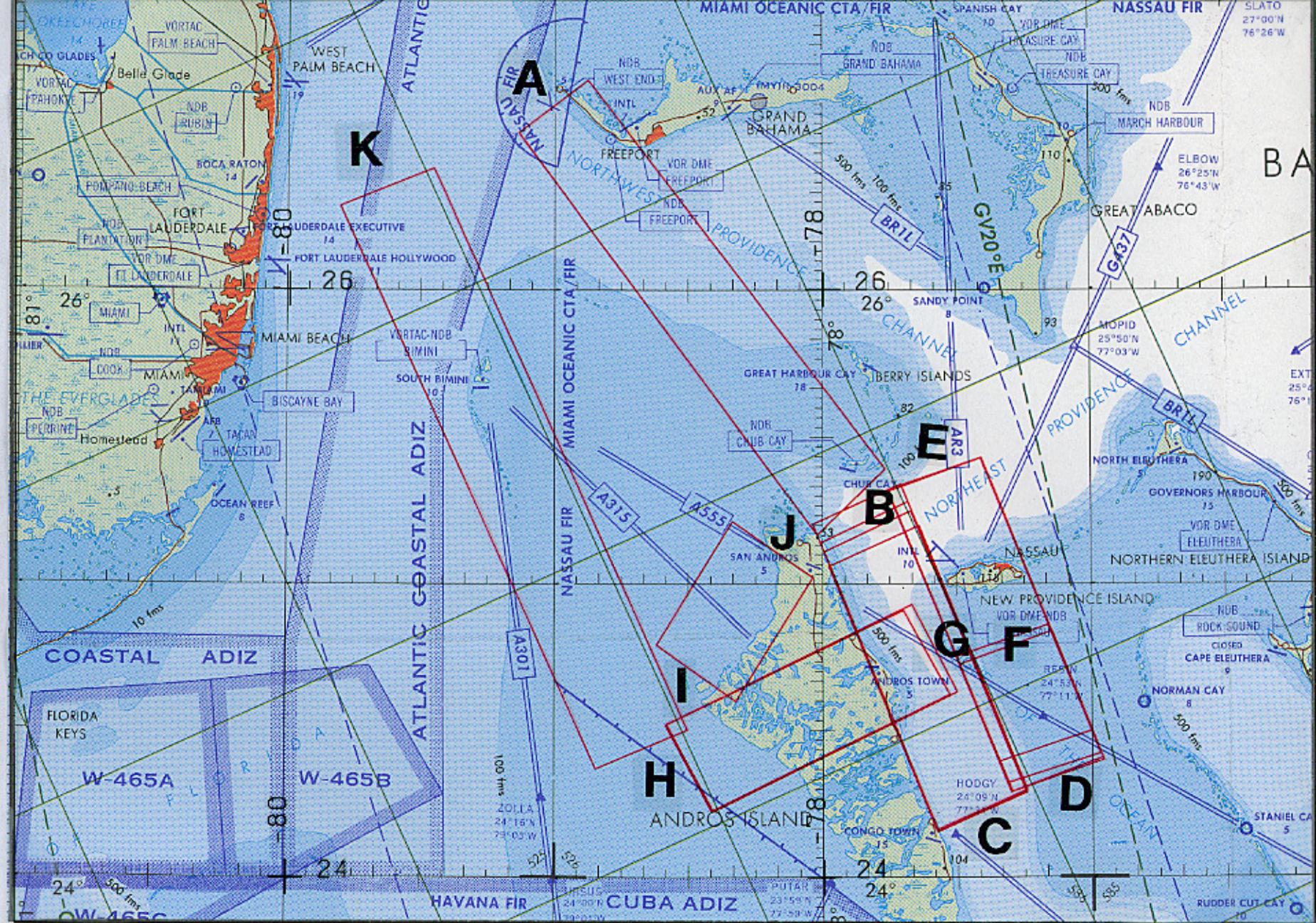


FLIGHT 98-117

13 SEPTEMBER 1998

A/C 806

CAMEX-III



FLIGHT SUMMARY REPORT

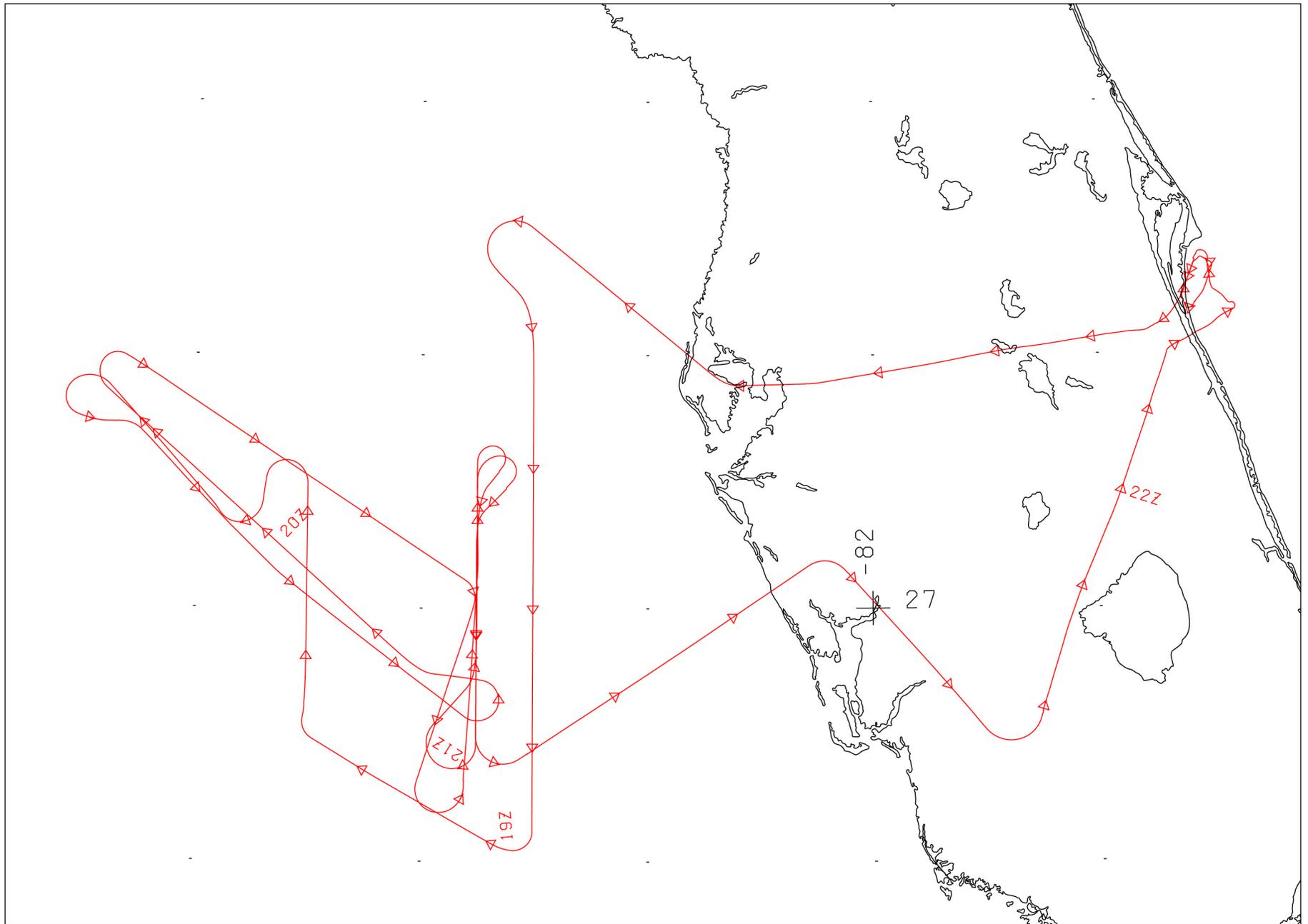
Flight Number: 98-118
Calendar/Julian Date: 17 September 1998 • 260
Sensor Package: Multispectral Atmospheric Mapping
Sensor (MAMS)
Area(s) Covered: Florida Coast – Gulf of Mexico (CAMEX III)

Investigator(s): Hood and Guillory, MSFC

Aircraft #: 806

SENSOR DATA

Accession #: ----
Sensor ID #: 102
Sensor Type: MAMS
Focal Length: ----
Film Type: ----
Filtration: ----
Spectral Band: ----
f Stop: ----
Shutter Speed: ----
of Frames: ----
% Overlap: ----
Quality: Fair
Remarks:

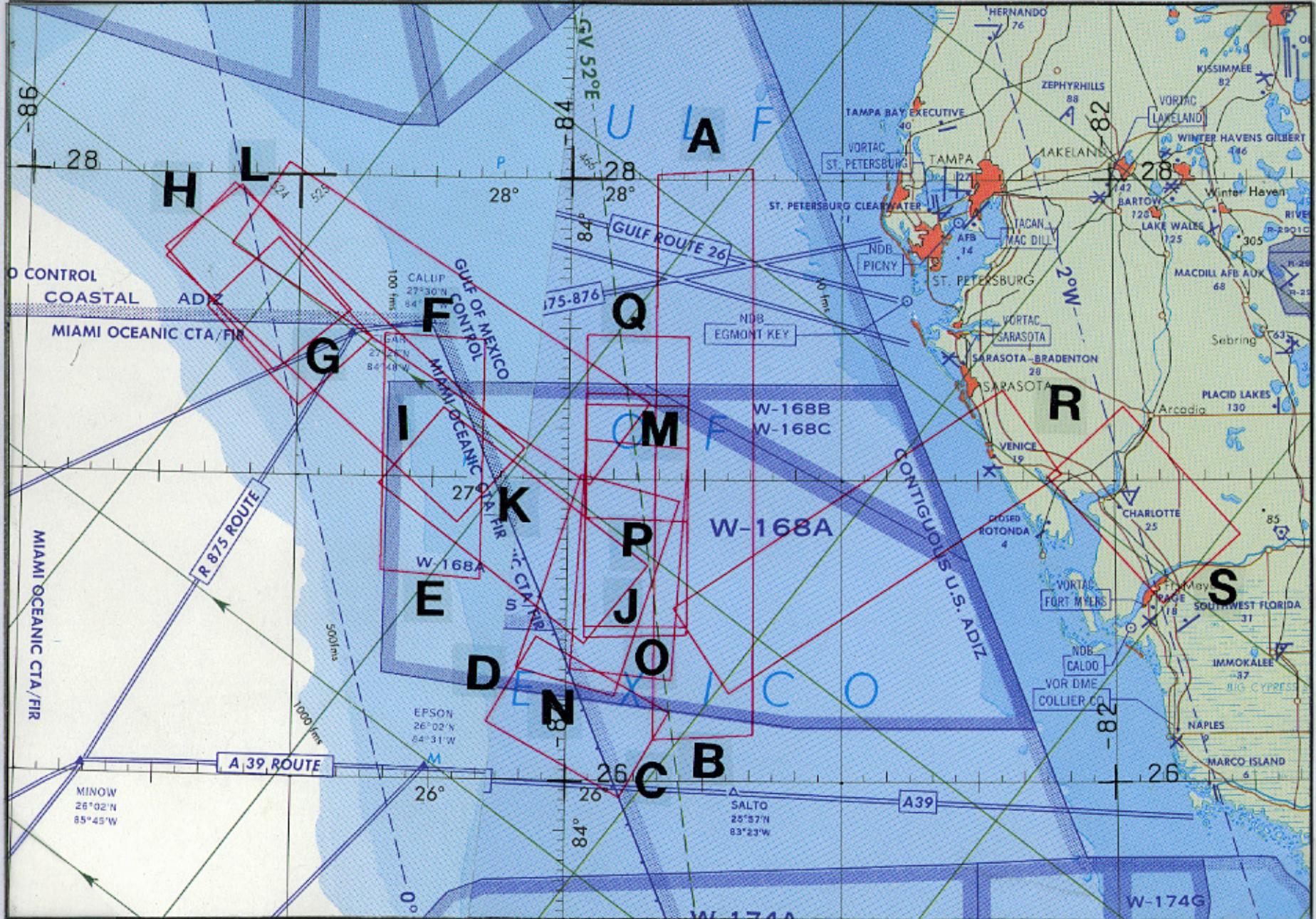


FLIGHT 98-118

17 SEPTEMBER 1998

A/C 806

CAMEX-III



FLIGHT 98-118

17 SEPTEMBER 1998

A/C 806

MMS

JNC 45

FLIGHT SUMMARY REPORT

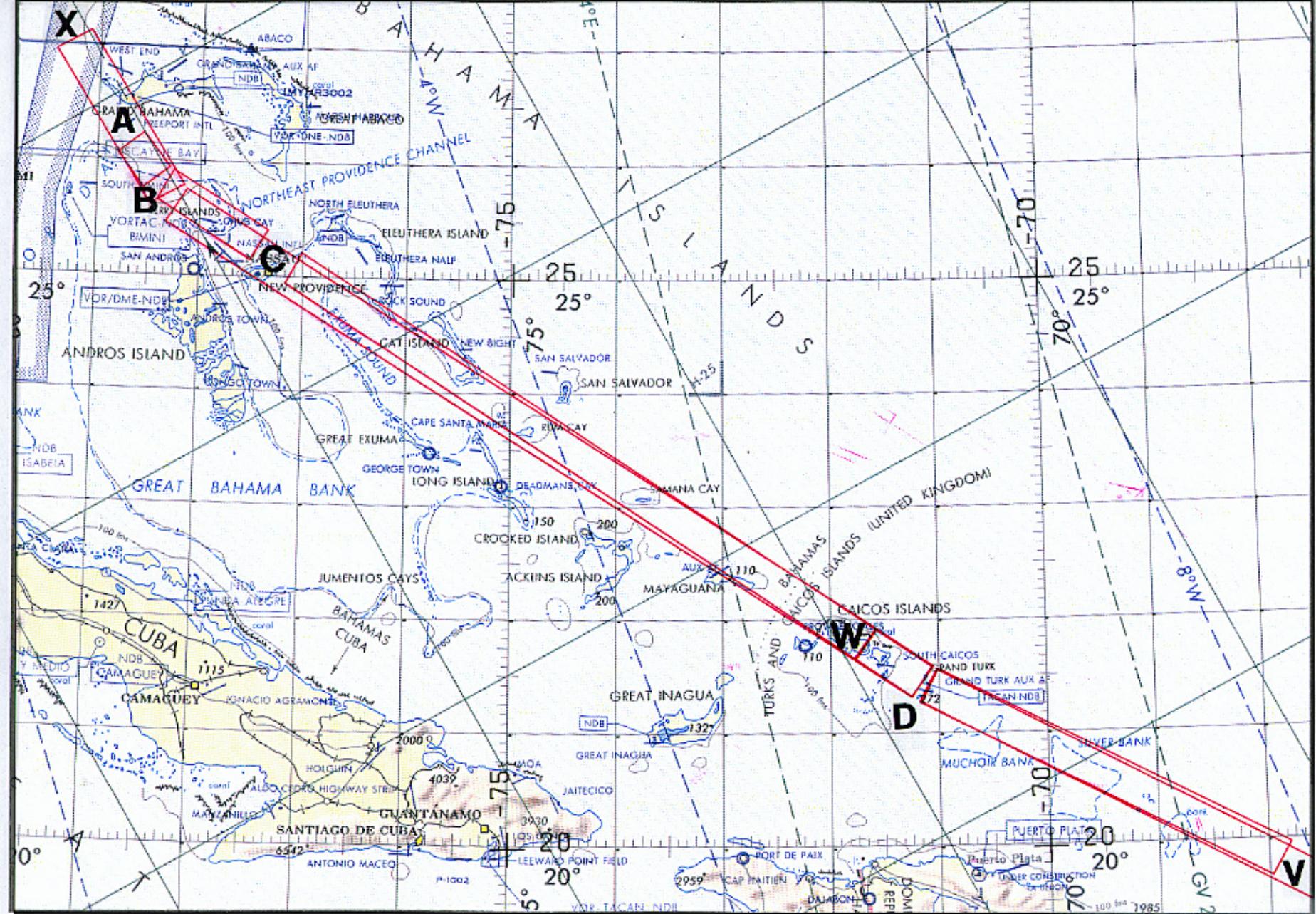
Flight Number: 98-119
Calendar/Julian Date: 21 September 1998 • 264
Sensor Package: Multispectral Atmospheric Mapping
Sensor (MAMS)
Area(s) Covered: Hurricane Georges – Virgin Islands (CAMEX III)

Investigator(s): Hood and Guillory, MSFC

Aircraft #: 806

SENSOR DATA

Accession #: ----
Sensor ID #: 102
Sensor Type: MAMS
Focal Length: ----
Film Type: ----
Filtration: ----
Spectral Band: ----
f Stop: ----
Shutter Speed: ----
of Frames: ----
% Overlap: ----
Quality: Good
Remarks:



FLIGHT 98-119

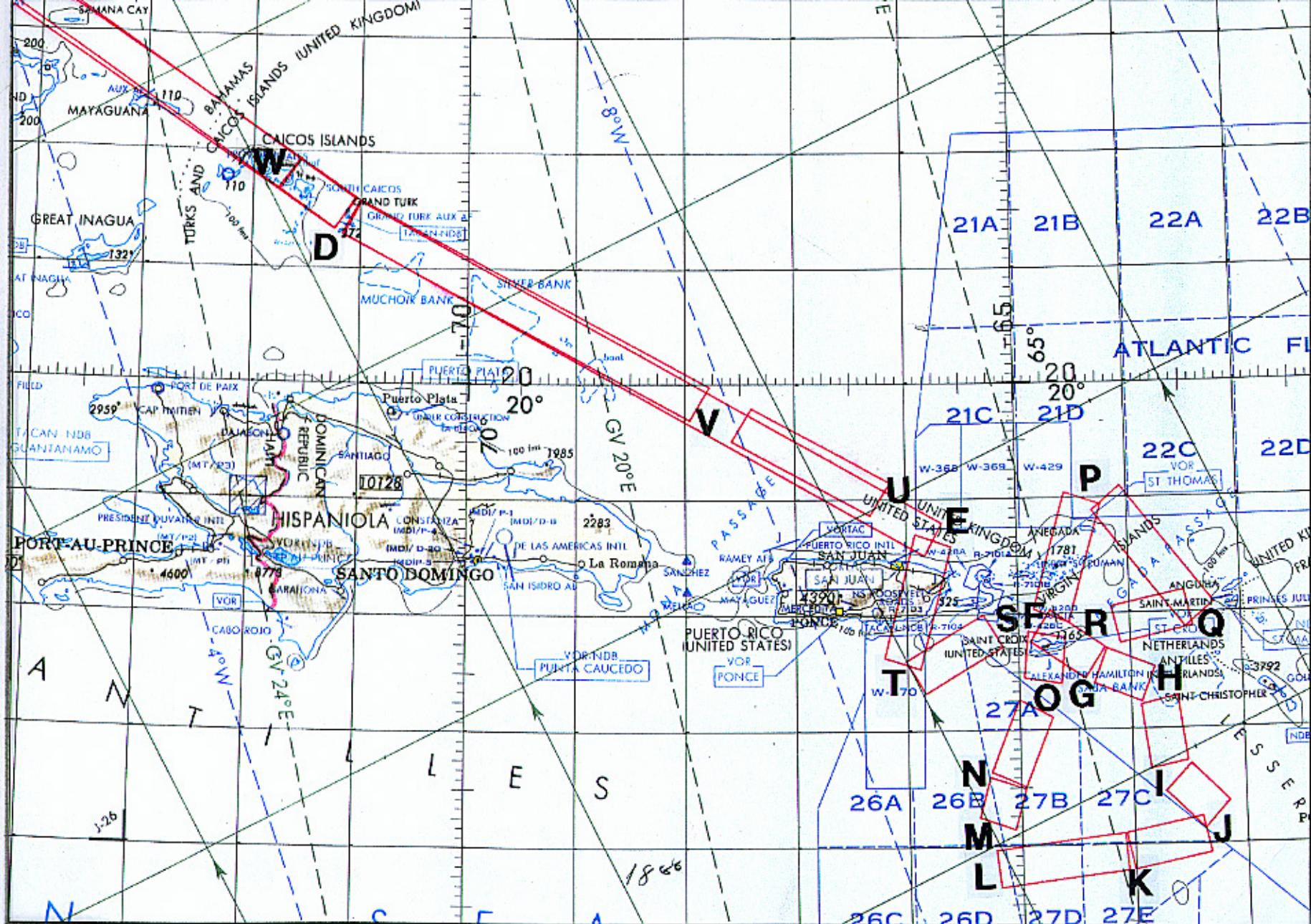
21 SEPTEMBER 1998

A/C 806

MAMS

(HURRICANE GEORGES)

GNC 9



FLIGHT SUMMARY REPORT

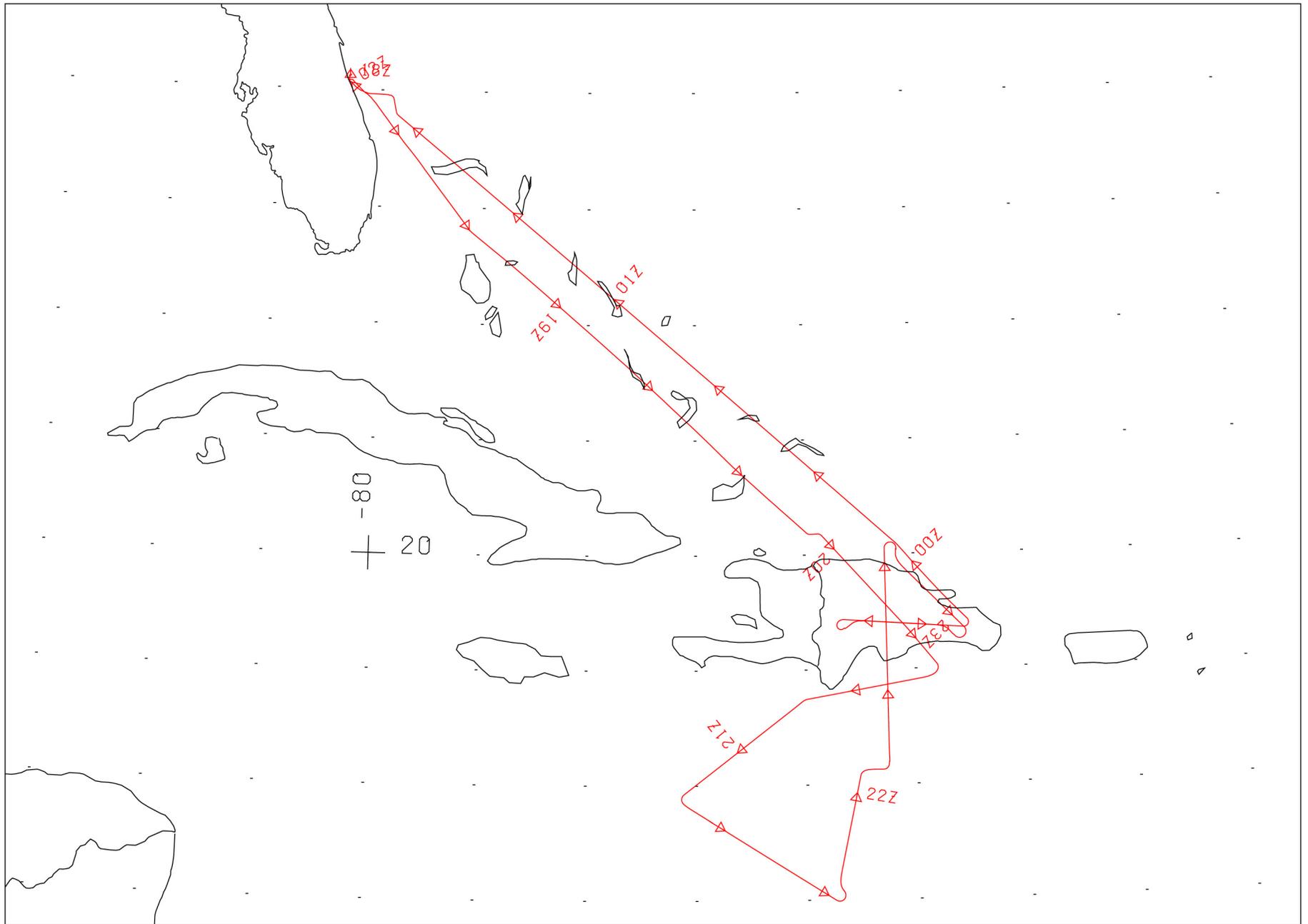
Flight Number: 98-120
Calendar/Julian Date: 22 September 1998 • 265
Sensor Package: Multispectral Atmospheric Mapping
Sensor (MAMS)
Area(s) Covered: Hurricane Georges – Hispanola (CAMEX III)

Investigator(s): Hood and Guillory, MSFC

Aircraft #: 806

SENSOR DATA

Accession #: ----
Sensor ID #: 102
Sensor Type: MAMS
Focal Length: ----
Film Type: ----
Filtration: ----
Spectral Band: ----
f Stop: ----
Shutter Speed: ----
of Frames: ----
% Overlap: ----
Quality: Good
Remarks:



FLIGHT 98-120

22-23 SEPTEMBER 1998

A/C 806

CAMEX III

(HURRICANE GEORGES)



FLIGHT 98-120

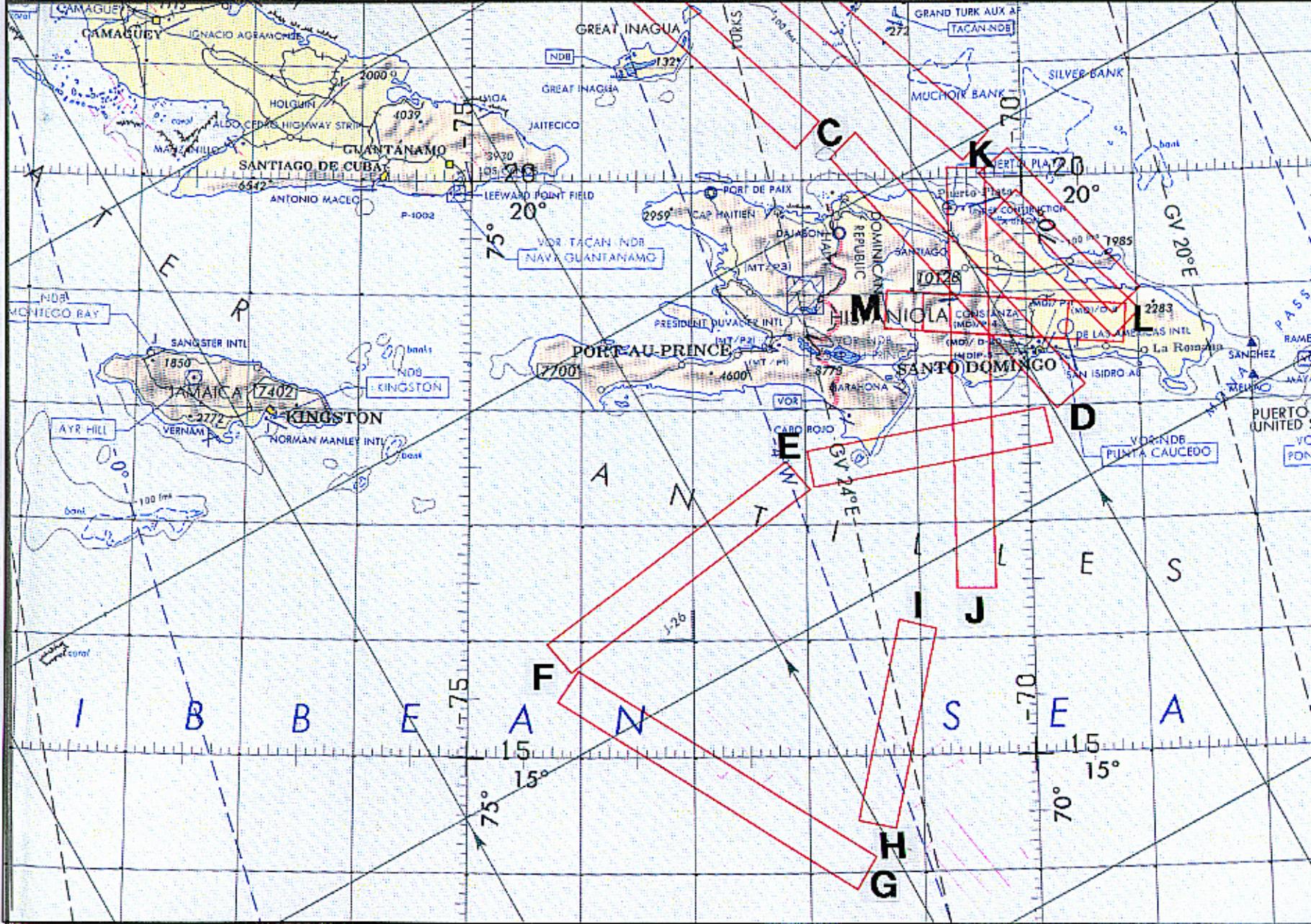
22-23 SEPTEMBER 1998

A/C 806

MAMS

(HURRICANE GEORGES)

GNC 9



FLIGHT 98-120 22-23 SEPTEMBER 1998 A/C 806 MAMS (HURRICANE GEORGES) GNC 9

FLIGHT SUMMARY REPORT

Flight Number: 98-132
Calendar/Julian Date: 23 September 1998 • 266
Sensor Package: Multispectral Atmospheric Mapping
Sensor (MAMS)
Area(s) Covered: Ferry – Patrick AFB to Warner Robbins AFB

Investigator(s): Hood and Guillory, MSFC

Aircraft #: 806

SENSOR DATA

Accession #: ----
Sensor ID #: 102
Sensor Type: MAMS
Focal Length: ----
Film Type: ----
Filtration: ----
Spectral Band: ----
f Stop: ----
Shutter Speed: ----
of Frames: ----
% Overlap: ----
Quality: No data collected
Remarks:

FLIGHT SUMMARY REPORT

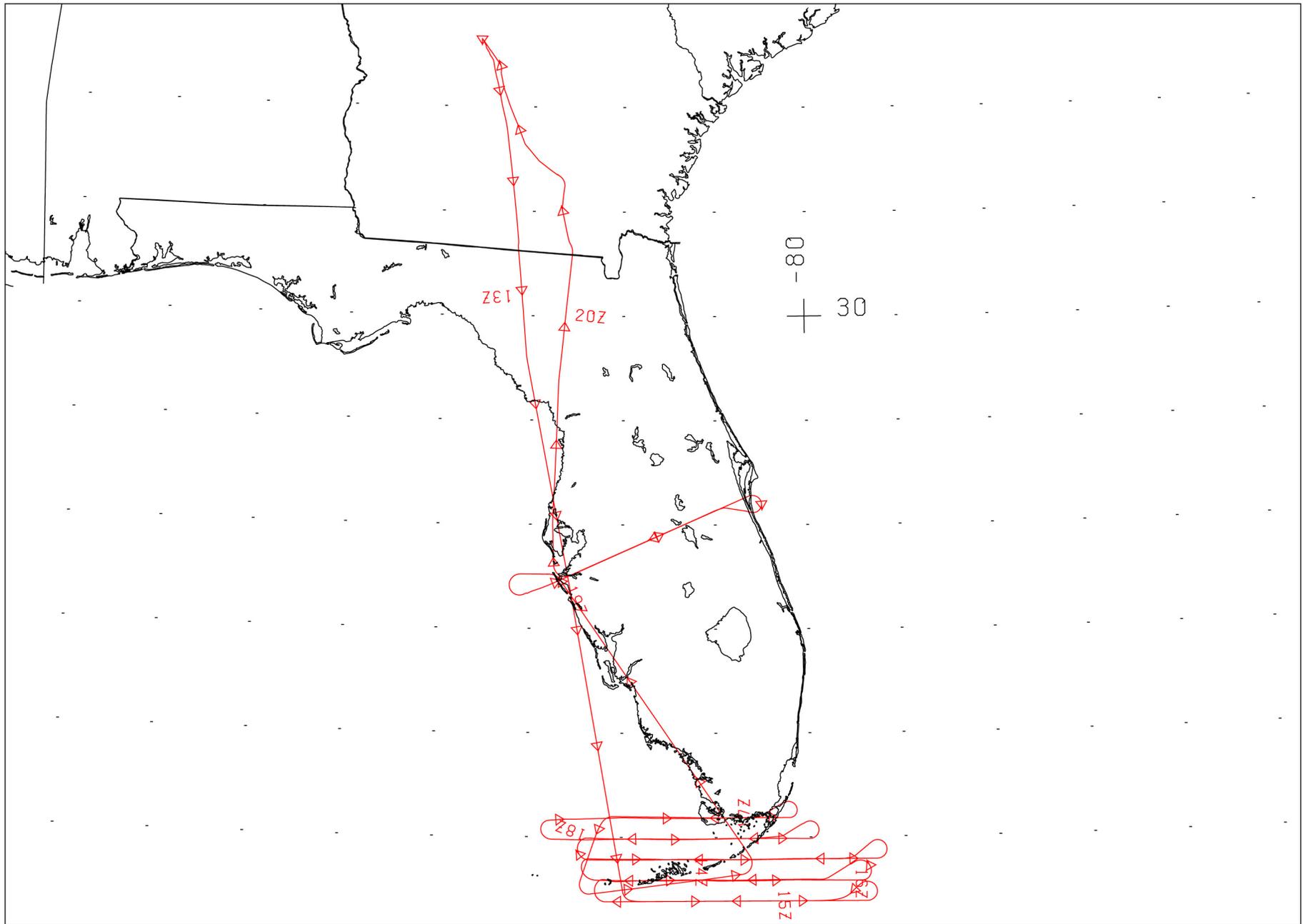
Flight Number: 98-136
Calendar/Julian Date: 25 September 1998 • 268
Sensor Package: Multispectral Atmospheric Mapping
Sensor (MAMS)
Area(s) Covered: Hurricane Georges – South Florida Keys (CAMEX III)

Investigator(s): Hood and Guillory, MSFC

Aircraft #: 806

SENSOR DATA

Accession #: ----
Sensor ID #: 102
Sensor Type: MAMS
Focal Length: ----
Film Type: ----
Filtration: ----
Spectral Band: ----
f Stop: ----
Shutter Speed: ----
of Frames: ----
% Overlap: ----
Quality: Fair
Remarks:



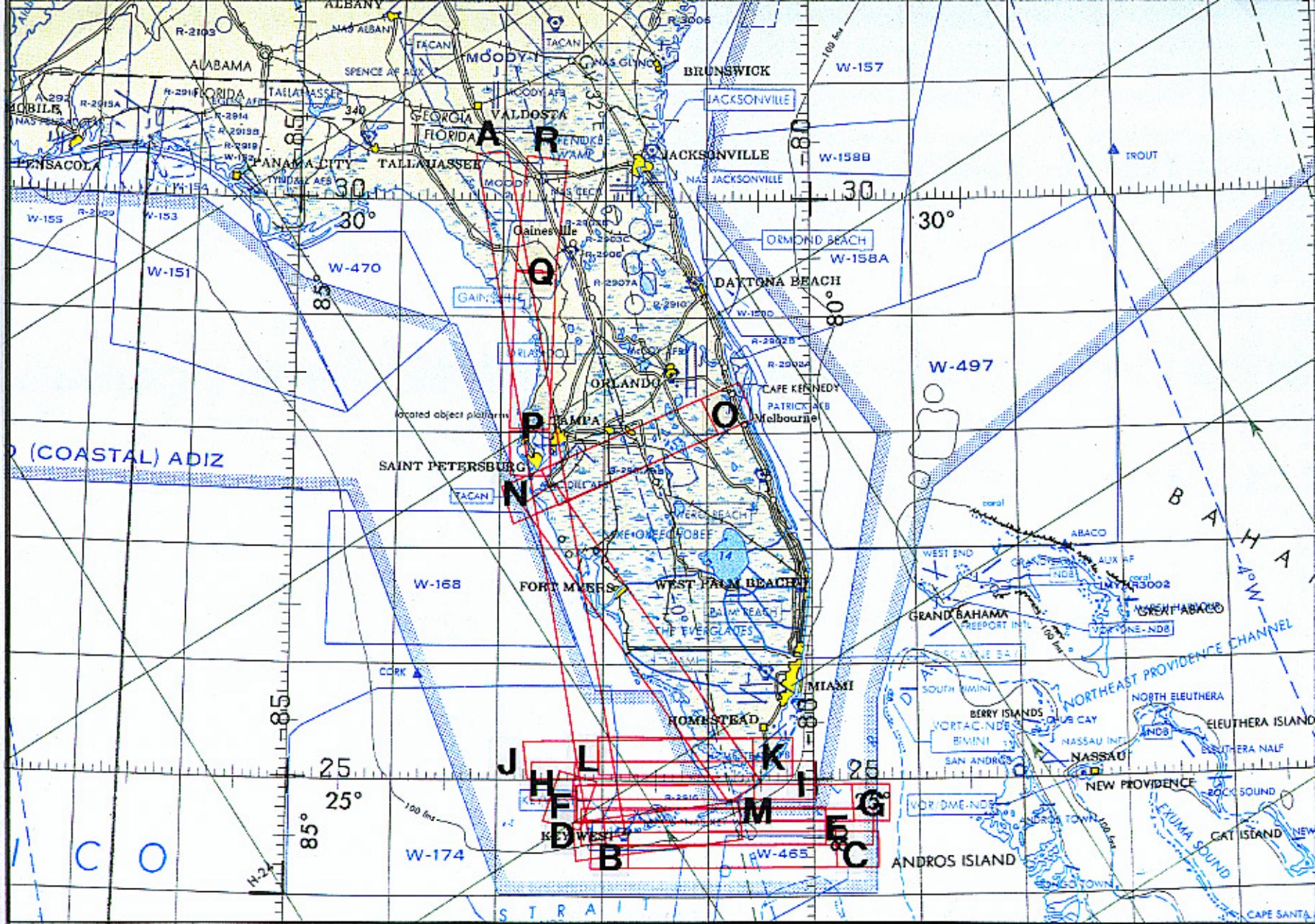
FLIGHT 98-136

25 SEPTEMBER 1998

A/C 806

CAMEX-III

(HURRICANE GEORGES)



FLIGHT 98-136

25 SEPTEMBER 1998

A/C 806

MAMS

(HURRICANE GEORGES)

GNC 9

FLIGHT SUMMARY REPORT

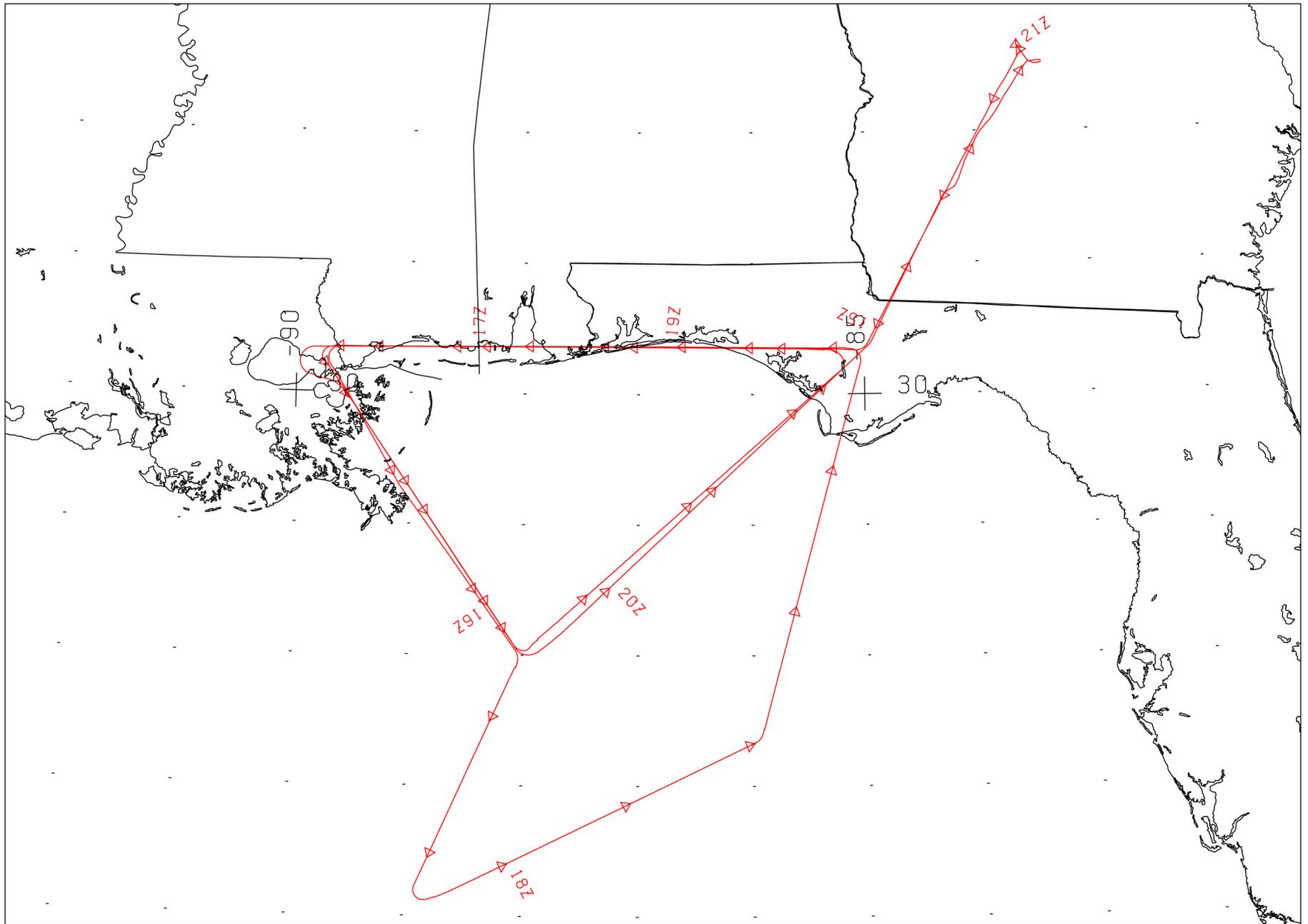
Flight Number: 98-137
Calendar/Julian Date: 27 September 1998 • 270
Sensor Package: Multispectral Atmospheric Mapping
Sensor (MAMS)
Area(s) Covered: Hurricane Georges – Gulf Coast (CAMEX III)

Investigator(s): Hood and Guillory, MSFC

Aircraft #: 806

SENSOR DATA

Accession #: ----
Sensor ID #: 102
Sensor Type: MAMS
Focal Length: ----
Film Type: ----
Filtration: ----
Spectral Band: ----
f Stop: ----
Shutter Speed: ----
of Frames: ----
% Overlap: ----
Quality: Good
Remarks:



FLIGHT 98-137

27 SEPTEMBER 1998

A/C 806

CAMEX-III

(HURRICANE GEORGES)



FLIGHT SUMMARY REPORT

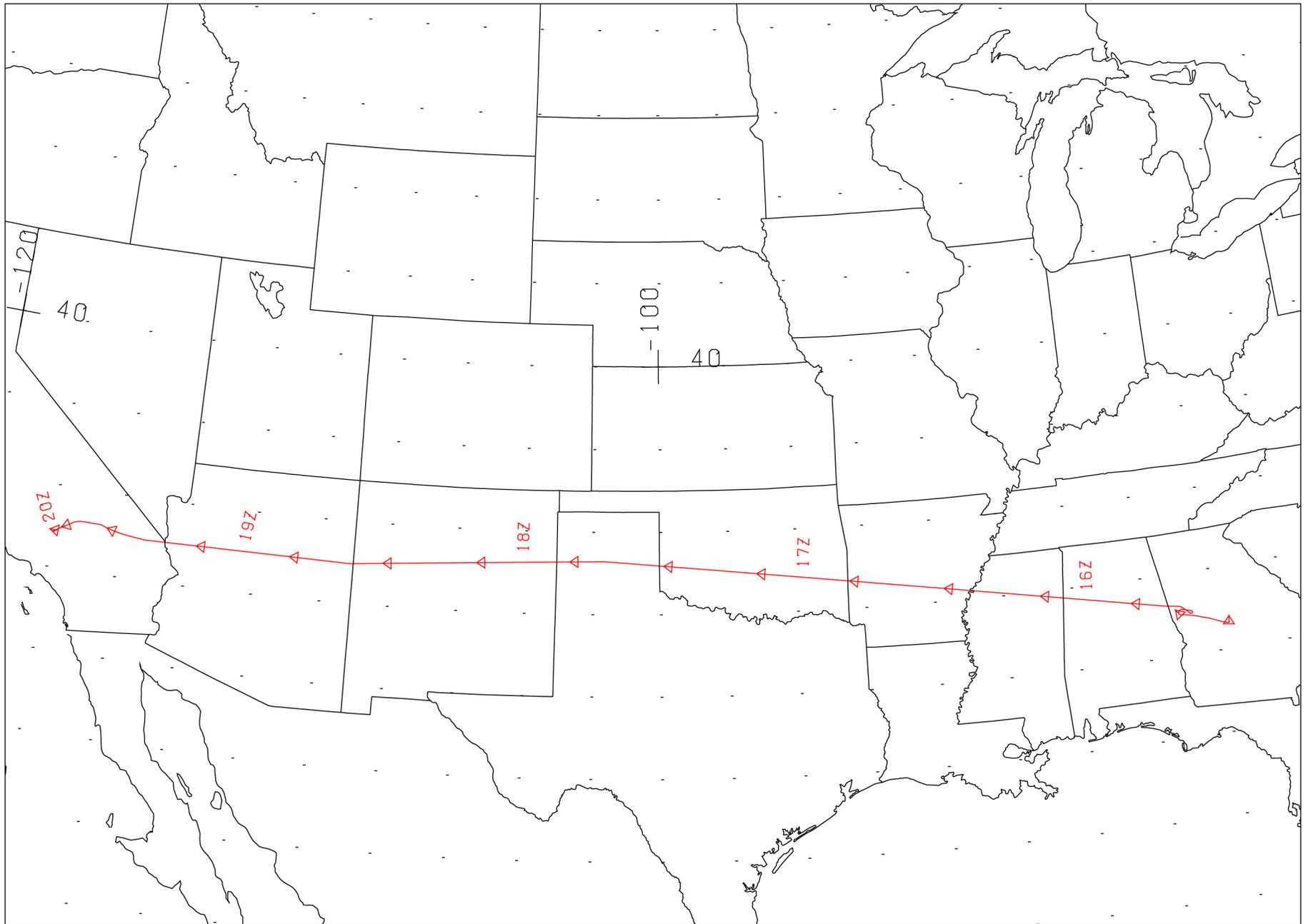
Flight Number: 98-138
Calendar/Julian Date: 28 September 1998 • 271
Sensor Package: Multispectral Atmospheric Mapping
Sensor (MAMS)
Area(s) Covered: Ferry – Warner Robbins AFB to Dryden (CAMEX III)

Investigator(s): Hood and Guillory, MSFC

Aircraft #: 806

SENSOR DATA

Accession #: ----
Sensor ID #: 102
Sensor Type: MAMS
Focal Length: ----
Film Type: ----
Filtration: ----
Spectral Band: ----
f Stop: ----
Shutter Speed: ----
of Frames: ----
% Overlap: ----
Quality: No data collected
Remarks:



FLIGHT 98-138

28 SEPTEMBER 1998

A/C 806

CAMEX-III

(FERRY WARNER ROBBINS AFB --> DRYDEN)