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AIRBORNE RESEARCH METEOROLOGICAL DATA COLLECTED BY THE NATIONAL HURRICANE RESEARCH LABORATORY (HURRICANE RESEARCH DIVISION/AOML) DURING THE 1982-1983 HURRICANE SEASONS--INVENTORY AND AVAILABILITY

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PREFACE

The history, nature, use, and availability of in-situ research meteorological data that have been gathered by specially instrumented aircraft have been described in several publications. (See bibliography for a partial list.) In 1982, the National Hurricane Research Laboratory (NHRL), now Hurricane Research Division (HRD)/Atlantic Oceanographic and Meteorological Laboratory (AOML), published NOAA Data Report ERL AOML-2 (Friedman et al.) to document the airborne research meteorological data collected in support of its hurricane field programs during the WP-3D era (1976-1981). The present publication continues this documentation with an inventory and description of the research data that were obtained during the 1982 and 1983 hurricane seasons, and which are available at HRD/AOML.[1]

Increased data reliability, innovative automated and interactive data processing and analysis capabilities, and new instrumentation systems, such as airborne Doppler radar, have rekindled the interests of many government and university scientists in using these new data sets for hurricane research. This report is intended to facilitate such research efforts.

This publication follows the format used in Friedman et al. (1982). Part I contains background material. Also in part I is an updated history of HRD and a description of NOAA's efforts to collect in-situ meteorological data in hurricanes with aircraft. A data inventory, by individual mission, is presented in part II. Flight information has been grouped and storm-referenced sequentially (by year and date). Best-track plots (official storm-center positions) are shown for the storms investigated by NHRL during the 1982, and by HRD during the 1983, Atlantic and Eastern Pacific hurricane seasons. Full disc/infrared (FD/IR) satellite photographs present each storm's gross structure and location at the approximate midpoint time of each mission.

No attempt has been made to fully document the conversion or calibration factors and equations used by the Research Facilities Center (RFC), now the Office of Aircraft Operations (OAO), to convert "raw" data to "final" data in engineering units. Such factors and equations are subject to periodic change. However, the RFC standard tape format/output has been, for the most part, consistent during 1982-1983 to facilitate its use by the researcher.

Howard A. Friedman

Miami, Florida
November 1984

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1. The name National Hurricane Research Laboratory (NHRL) was changed to Hurricane Research Division (HRD) as of 1983. Therefore, the group is referred to, in this publication, as the NHRL when hurricane research activities of 1982 are described and as the HRD for 1983 events.

PART I. THE HURRICANE RESEARCH DIVISION/AOML

1. History

A series of devastating hurricanes that impacted the populous east coast of the United States in 1954 and 1955 provided the impetus to accelerate research efforts on the hurricane prediction problem. In 1955, Congress mandated that the United States Weather Bureau (USWB) take immediate action to establish a major hurricane research program. This program became the responsibility of the National Hurricane Research Project (NHRP), which was established in 1956 under the USWB's Office of Meteorological Research (OMR).

Initially, three aircraft were provided and operated by the U.S. Air Force and instrumented by the USWB to support NHRP's data collection program in the hurricane seasons of 1956 through 1958. During these years, considerable strides were made in joining a variety of sensors and supporting instrumentation to provide in-situ meteorological data in a form suitable for research application (Reber and Friedman, 1964). As these data were analyzed, it became evident that additional investigative work was necessary to provide scientists with a more complete description of the hurricane.

Accordingly, after the joint Department of Commerce (DOC)/Department of Defense (DOD) agreement to provide aircraft support for this program had expired, the USWB obtained, in 1959, two DC-6 airplanes. A B-57A aircraft was also transferred from DOD to DOC. These three aircraft, which became known as "flying research laboratories," were instrumented and placed in service during the 1960 hurricane season. One year later, the Flight Operations Group of NHRP became a separate entity -- the Research Flight Facility.

In the early 1960's, a program of hurricane modification research (Project Stormfury) was established by the USWB and was operated from a project office in Washington, D.C. Other events, many of which had some impact on NHRP, took place during the mid- and late 1960's.

The USWB became a major component of the Environmental Science Services Administration (ESSA) and OMR formed the basis of the Institutes for Environmental Research, renamed the Environmental Research Laboratories (ERL), in 1965. NHRP attained laboratory status and was renamed the National Hurricane Research Laboratory in recognition of the need for a longer range program of hurricane prediction research than had been envisioned in 1956.

The responsibility for hurricane modification research was assigned to NHRL in 1967. Project Stormfury was destined to become the major component of NHRL's research program for much of the following decade. Also, in 1967, ESSA formed the Atlantic Oceanographic and Meteorological Laboratories (AOML) with headquarters in Miami, Florida. NHRL was absorbed into this new organization.

Hurricane Debbie was seeded with silver iodide crystals in 1969. Observed changes in the storm's intensity and structure seemed to be consistent with the postulated sequence of events in the Project Stormfury hypothesis. These results produced a wave of optimism throughout DOC that was to have a major impact on the future of NHRL.

In 1970, ESSA, after a reorganization, became the National Oceanic and Atmospheric Administration (NOAA). Largely as a result of the Debbie seeding, NHRL was removed from AOML in 1971 and placed directly under the Director of ERL's Weather Modification Program Office (WMPO) in Boulder, Colorado. This event marked the point at which the original purpose of NHRP (NHRL), to conduct research for improved hurricane prediction, was replaced in favor of the hurricane modification assignment.

During 1970-1972, the activities of Project Stormfury were accelerated to obtain a large sample of seeded storm cases. This extensive data collection was necessary so that scientists could determine if results similar to those obtained in Debbie were repeatable with some degree of consistency. To take advantage of a high climatological frequency of suitable storms, DOC decided to transfer the seeding project from the Atlantic to the Pacific Ocean. However, before that transfer could be effected, new research aircraft and state-of-the-art instrumentation had to be procured. It was decided to stand Project Stormfury down during 1973-1975 while new aircraft were obtained and instrumented.

By 1975, WMPO merged NHRL with the Experimental Meteorology Laboratory (EML), another Miami-based group. EML's research was focused on rainfall enhancement through silver iodide seeding of summer cumulus clouds. The new organization, which was named the National Hurricane and Experimental Meteorology Laboratory (NHEML), consisted of four groups. The Hurricane, Modeling, and Analytical Studies Groups were from NHRL. The Cumulus Group was from EML. An experiment known as the Florida Area Cumulus Experiment (FACE) was the primary responsibility of the Cumulus Group, while the other NHEML groups concentrated on Stormfury-related research.

As a result of another reorganization, in 1978 NHEML was removed from WMPO and reported directly to the Director of ERL. However, in 1979 the Administrator of NOAA directed that NHEML be merged again with AOML. With FACE completed by the fall of 1980, the Cumulus Group of NHEML was assigned to a new organization known as the Office of Weather Research and Modification (OWRM). By October of 1981 the remaining groups in NHEML were organized into a formal subcomponent of AOML and renamed NHRL. In 1983, NHRL, now renamed the Hurricane Research Division (HRD), joined other AOML divisions on Virginia Key, Florida -- its present location.

Throughout the course of the 1970's, the fortunes of Project Stormfury peaked and waned a number of times. Despite the budget reductions of 1973, NOAA procured two new Orion (WP-3D) aircraft [Fig. 1] and equipped them with state-of-the-art instrumentation and recording systems. By the time that these aircraft were available for full meteorological research service, it was clear that Stormfury could not be transferred to the Pacific (mainly because of complex international factors). Although consideration was given to seeding Atlantic storms in 1977, 1978, and 1980, no suitable hurricanes occurred in those years in the "permissible" seeding area. Thus, no storms have been seeded since the acquisition of the new NOAA aircraft.

From a scientific point of view, observations made with the WP-3D aircraft have revealed that hurricanes are far more complicated than was thought to be the case when the Stormfury hypothesis was developed in the 1960's. Furthermore, variations similar to those observed in Debbie and, at the time,

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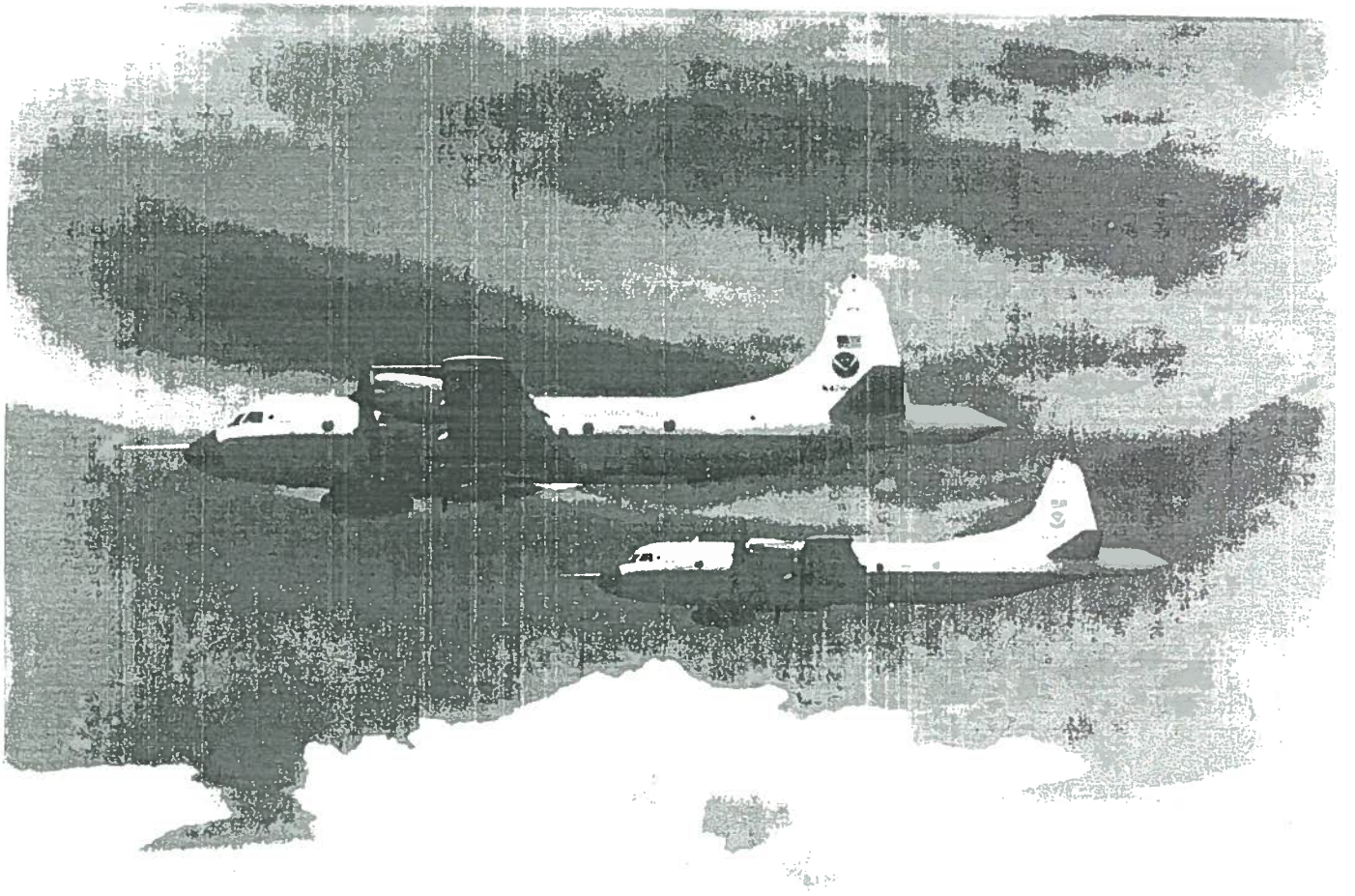


Fig. 1. NOAA/RFC (OAO) WP-3D aircraft.

attributed to man's intervention, have since been observed to occur naturally in several hurricanes since 1977.

Beginning with the fiscal year 1980 budget, funds for hurricane prediction research were increased substantially. Stormfury, which had occupied most of NHRL's resources, was formally ended in 1982. The emphasis of HRD's research is now fully focused on the many aspects of the hurricane prediction problem.

Stanley R. Rosenthal
Deputy Director, Atmospheric Programs, AOML

2. Hurricane Field Programs

2.1 Objectives in 1982

The objective of HRD's hurricane field research program is to assemble descriptive data for analytical and theoretical studies that are designed to provide an optimum understanding of hurricane characteristics. The ultimate purpose of this research is to establish improved methods of hurricane prediction.

The principal investigations of NHRL's 1982 hurricane field program were the environmental synoptic-scale flow [Omega dropwindsonde (ODW)] experiment; and the planetary boundary-layer (PBL) experiment. Plans for other studies were to be implemented if storm conditions were unsuitable for either of the principal missions or if additional research flight hours were made available to NHRL.

The ODW experiment was designed to document the environmental synoptic-scale flow in the middle and lower troposphere over the ocean at 150 to 1500 km from the center of mature hurricanes [Fig. 2]. Observations, gathered at flight level by the NOAA aircraft and below flight level by ODW's, are being studied to assess their relative importance for improving short-range (24 to 36 h) hurricane track predictions. [See: DEBBY missions 820914I, 820914H, 820915I, and 820915H; and OLIVIA missions 820923I, 820923H, 820924H, and 820924I.]

The PBL experiment [Fig. 3] seeks to improve understanding of the: (1) structure of the hurricane planetary boundary layer and the role it plays in hurricane dynamics; and (2) response of the ocean to wind forcing (i.e., wind waves and storm surge). Part of this experiment seeks to document the structure of the PBL between inner rainbands and to determine the operational feasibility of flight patterns to be used in subsequent PBL missions. Wave and surge studies are directed toward developing the capability to forecast wave heights accurately in the outer regions of the storm and to correlate wave direction with the wind field. [See: DEBBY mission 820914I.] In addition, plans to collect cloud physics data, to improve understanding of observed convective and stratiform features in the vicinity of the eyewall and inner rainbands, and to conduct missions in support of landfalling hurricane studies, were developed as "piggyback" or alternate experiments in 1982.

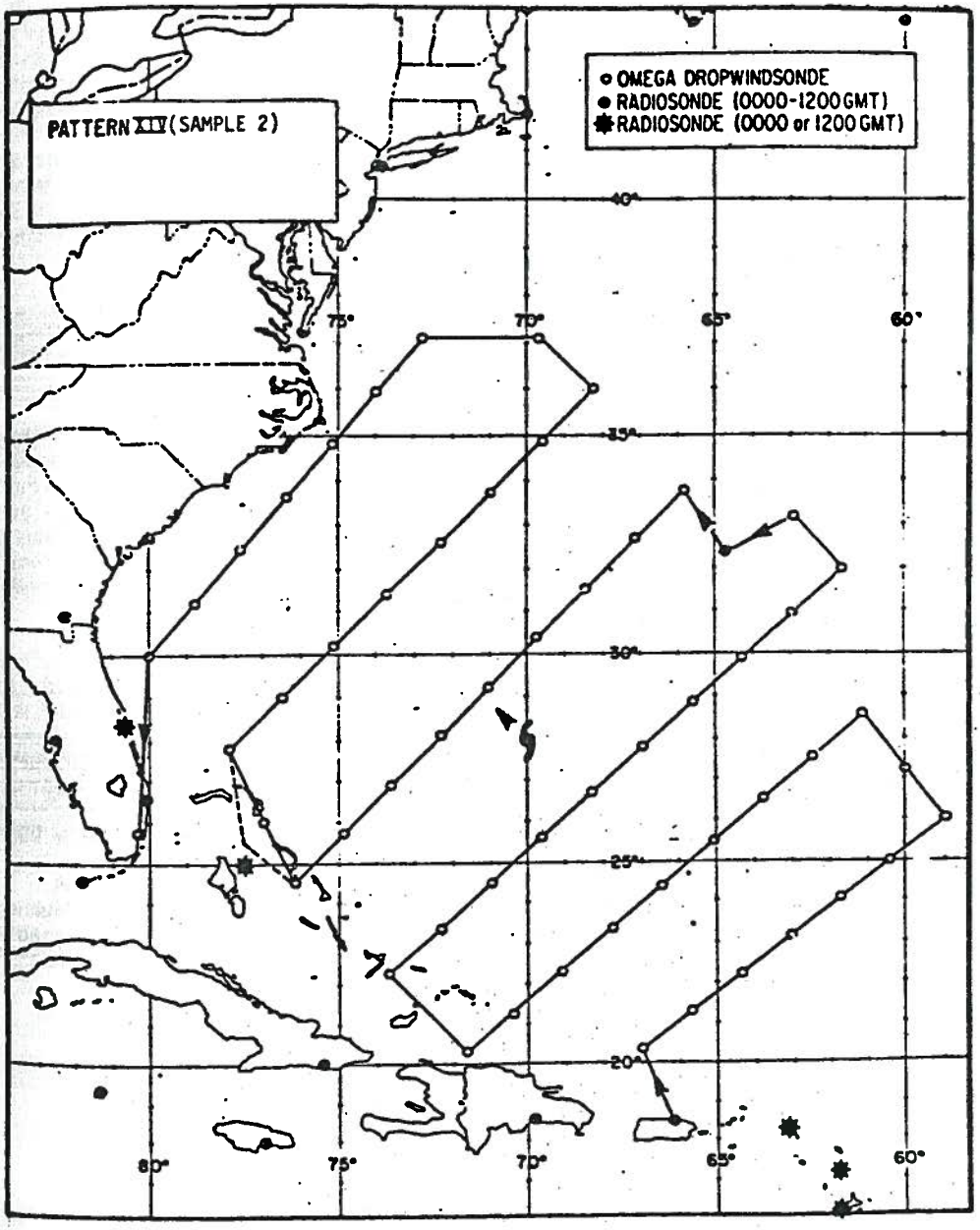


Fig. 2. Idealized pattern for the synoptic-flow (ODW) experiment.

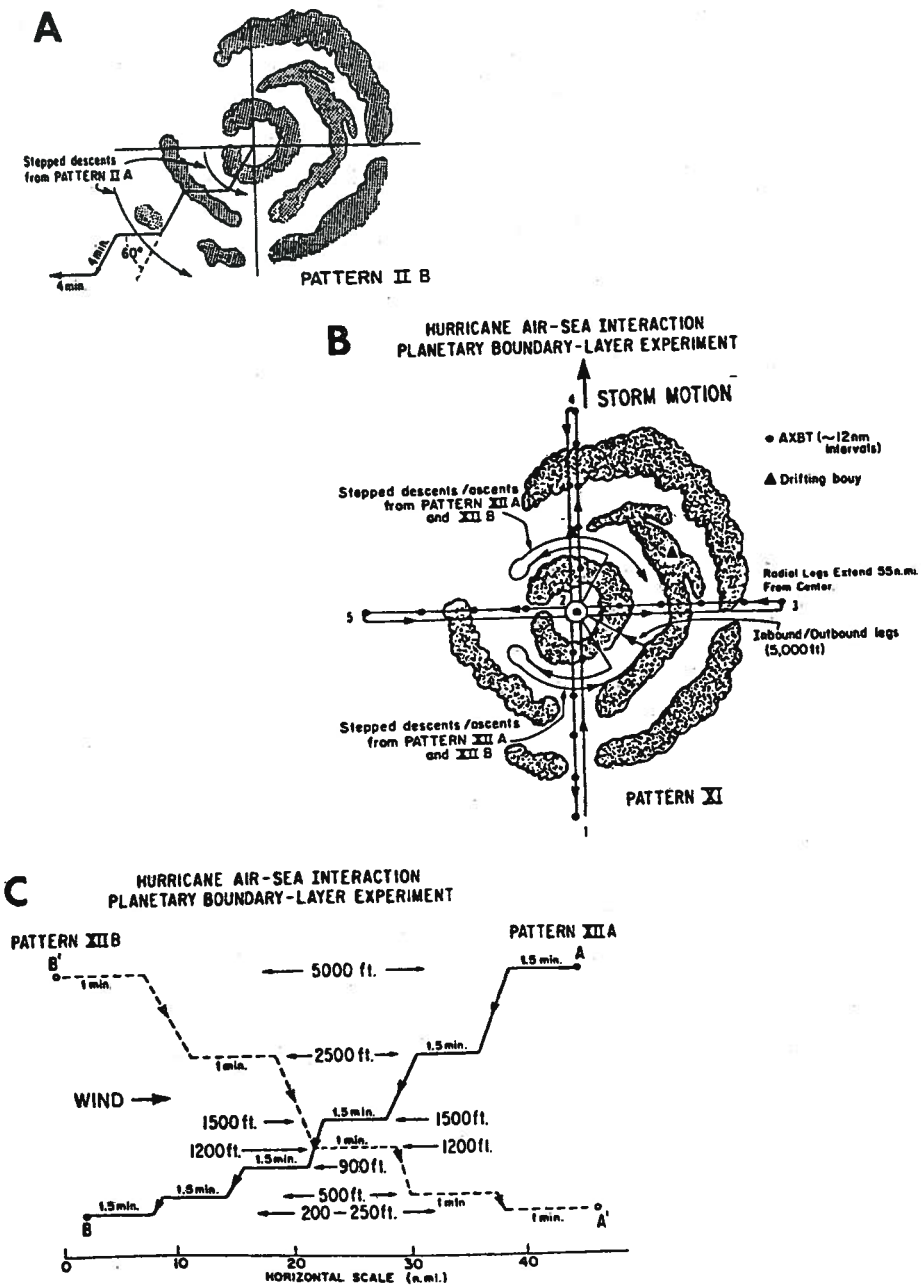


Fig. 3. Idealized patterns for the hurricane air-sea interaction/planetary boundary-layer experiment.

2.2 Objectives in 1983

Three principal experiments were developed for HRD's 1983 hurricane field program: (1) observation of the horizontal structure at a single level in a hurricane over 24 to 36 hours [long-term monitoring (LTM) experiment]; (2) enhanced understanding and documentation of the convective dynamics of hurricane rainbands using NOAA's new airborne Doppler radar [convective dynamics (CDYN) experiment]; and (3) a continuation of the study of the structure and dynamics of the atmospheric and oceanic boundary layers in hurricanes [air-sea interaction (ASI) experiment]. Aside from these primary experiments, plans were developed to conduct backup, alternate and piggyback missions for the support of other HRD experiments and related programs in 1983.

When analyzed, data collected during LTM missions allow scientists to document the evolution and asymmetries of the vortex [Fig. 4]. Such data also permit them to evaluate models of the storm's dynamics as well as track predictions.

During the 1983 field program, if the location of a given storm was unfavorable to conduct the basic vortex dynamics experiment, another option was employed. In this alternative mode, data to explore the way in which the vortex flow matches the environmental flow could be obtained. In effect, this option of the experiment matches the environmental steering current and the tropical cyclone vortex core by extending the observations over a large area. [See: ALICIA missions 830816H, 830817I1, 830817H, 830817I2, and 830818H; BARRY missions 830823I and 830825H; and, DEAN missions 830929H1 and 830929I.]

Data collected as part of the CDYN experiment [Fig. 5] are being used to evaluate numerical hurricane models. A collateral goal of this experiment is to obtain data suitable for conducting hurricane eyewall water budget studies. The latter also supports continuing studies of the mesoscale and microphysical aspects of hurricane precipitation. These data enable scientists to study the transports of moisture and precipitation particles from the eyewall into the surrounding region of the storm and the growth and fallout of ice particles transported into this region. [See: RAYMOND missions 831010I and 831010H; and TICO missions 831013I and 831013H.]

An operational feasibility study in support of the ASI experiment was conducted during the 1982 hurricane season. In 1983, the primary goal of this experiment was to provide data necessary to study the ocean's response to wind forcing. [See: DEAN mission 830928I.]

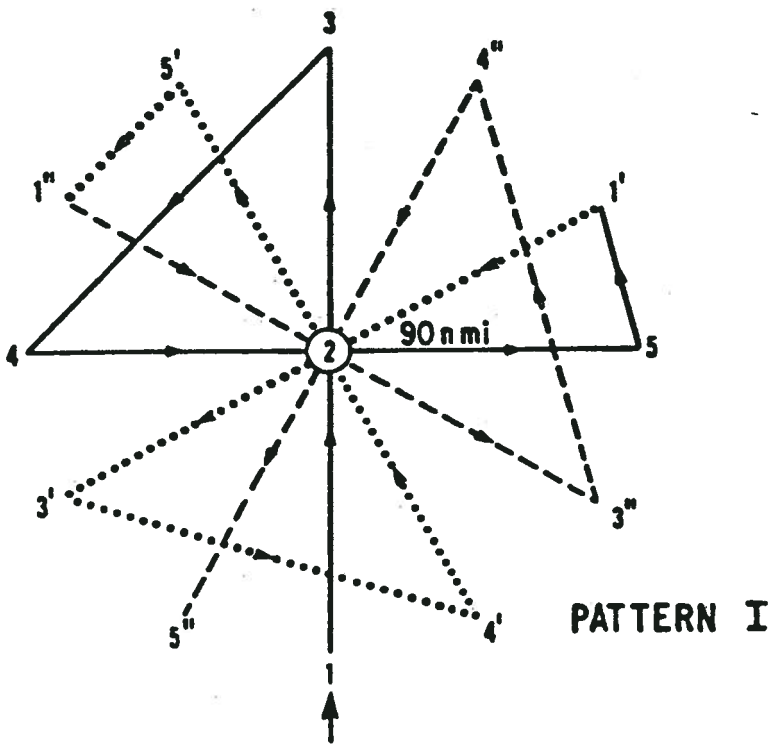
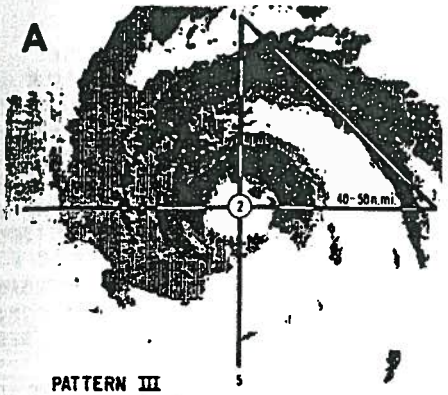


Fig. 4. Idealized pattern for the long-term monitoring experiment.

A



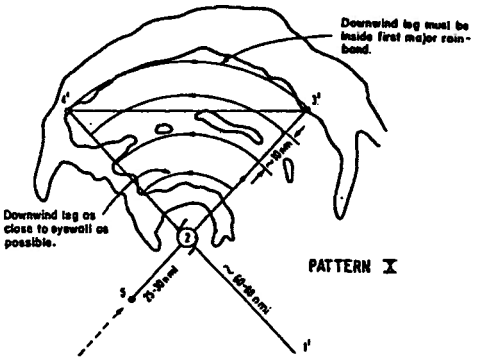
PATTERN III

CONVECTIVE AND MESOSCALE STUDIES (OPTION 1)

CONVECTIVE AND MESOSCALE STUDIES (OPTION 2)

NOAA 42 (CLOUD PHYSICS)

B

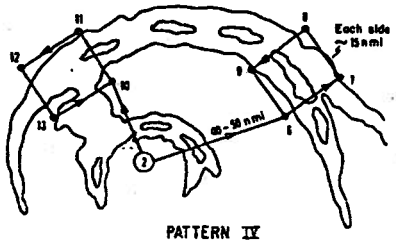


PATTERN I

CONVECTIVE AND MESOSCALE STUDIES (OPTION 1)

INTENSIVE INVESTIGATION PHASE (IIP) - NOAA 43

C



PATTERN IV

g. 5. Idealized patterns for the convective dynamics experiment.

PART II. DATA COLLECTION AND INVENTORY

1. Section, Figure, and Table Categories

Part II of this report is a catalog of the data collected, mainly with the NOAA/OAO aircraft, during the hurricane seasons of 1982 and 1983. These data directly support the NHRL/HRD hurricane field programs and related observational, analytical, and theoretical research. Typical NHRL/HRD research mission patterns are discussed in section 2. Best-track plots for Atlantic and Eastern Pacific storms flown for NHRL during 1982 and HRD in 1983 are presented in section 3. Individual (best-) storm tracks, marked to identify storm locations at the times of specified missions, are accompanied by a brief account of each storm's history. Satellite photos [section 4] are presented to visually orient the user with reference to the gross synoptic meteorological conditions that existed during individual missions. Typically, these satellite photos are for the approximate midtime of each mission specified. Thus, individual mission data, including the flight log, tape log, and equipment status form, are complemented by: (a) a reference to the research mission pattern completed; (b) best-track storm plots; (c) a brief account of the storm's history; and (d) satellite photos that correspond to the midtime of each mission discussed in the data inventory.

Table 1 identifies the typical NHRL/HRD research mission patterns flown during 1982-1983. Tables 2 and 3, respectively, relate official best-track storm plots to individual 1982-1983 research missions. Tables 4 and 5 reference the satellite photos contained in this report to these specific missions.

Data tape formats and, where appropriate, brief descriptions of instrument systems, are found in section 5. The information content of the flight and tape logs [section 6] and equipment status forms [section 7] is discussed before the presentation of data entries for each mission [section 8].

2. Typical NHRL/HRD Research Mission Patterns: 1982-1983

Table 1 cross-references the typical NHRL/HRD research patterns [Figs. 2 through 5] flown during the 1982 and 1983 hurricane seasons. The corresponding figure numbers are cited on individual flight logs in the inventory. For additional details, the user is directed to the 1982 and 1983 editions of NHRL and HRD Hurricane Field Program Plans.

In certain situations, such as when the center of a storm was over land, idealized mission patterns were modified to optimize both the storm center location and useful research data collection objectives. Investigative research flight patterns for weak tropical systems were designed on the basis of the system's size, strength, and location. Operational reconnaissance requirements [i.e., storm fix responsibility for the National Hurricane Center (NHC)] occasionally affected the design of research patterns.

For simplicity, whenever possible, typical research mission pattern designations are indicated on the flight logs of individual flights [sections 8.1 and 8.2]. Major deviations from these idealized patterns are also noted on these forms.

Table 1. Typical NHRL/HRD research mission patterns: 1982-1983

Mission type	Figure	Pattern	Ops plan[1] Year/page no.
Synoptic-flow (ODW)	2	I/Sample 2 XIV/Sample 2	1982/20 1983/41
Hurricane air-sea interaction (ASI)[2]/planetary boundary-layer (PBL)	3a 3b 3c	II B XI XII A	1982/24 1983/35 1983/36
Long-term monitoring (LTM)[3]/ vortex evolution (VE)[4] -- (option 1)	4	I	1983/22
Convective dynamics (CDYN)[5]/ rainband (RB)[6]/water budget (WB)[7]	5a 5b 5c	III IV X	1983/26 1983/27 1983/33

1. Refer to the appropriate annual NHRL or HRD Hurricane Field Program Plan (1982 or 1983) for further details.
2. ASI: Air-sea interaction (option of PBL experiment).
3. LTM: Long-term monitoring experiment.
4. VE: Vortex-evolution (option of LTM experiment).
5. CDYN: Convective dynamics experiment.
6. RB: Rainband (option of CDYN experiment).
7. WB: Water budget (option of CDYN experiment).

3. Best-Track Storm Plots

Operational storm tracks, whether constructed directly from aircraft, ship, or satellite observations, or determined from conventional synoptic data sources, are frequently subject to initial positioning errors. The verification of tropical cyclone forecasts by NHC and the Eastern Pacific Hurricane Center (EPHC) involves the determination of initial positioning errors. The magnitude (distance) of this error is given by the difference between the operationally determined and corrected initial storm positions. The latter is determined from the postanalysis of all available data.

The postanalysis process benefits from the use of additional data that may have been unavailable at the operational tracking time. The track, corrected for initial positioning errors and constructed from all available data sources, is referred to as the "best-track." It is believed to be reasonably conservative and representative of the storm's motion under the influence of synoptic-scale steering forces. Motions due to smaller scale steering forces are smoothed out during its construction.

The best-track storm positions for the 1982 and 1983 Atlantic and Eastern Pacific storms were provided, respectively, by NHC and EPHC. These tracks are listed in tables 2 and 3.

4. Satellite Imagery

The satellite photos presented in the data inventory [sections 8.1 and 8.2] have been selected to correspond to the approximate midtimes of the specified research missions (tables 4 and 5). All satellite photos shown are full-disc/infrared (FD/IR) taken from geostationary systems (GOES-EAST or GOES-WEST), and were provided by the Data Services Branch/Satellite Services Division, National Climatic Data Center, National Environmental Satellite, Data and Information Service (NESDIS)/NOAA. The satellite subpoints for GOES-EAST and GOES-WEST are, respectively, the equator at 75°W longitude and the equator at 135°W longitude.

5. Data Tape Formats

During 1982 and 1983, NHRL/HRD's research mission data were recorded by systems on the NOAA/RFC WP-3D aircraft with magnetic tape as the recording medium. Digitized radar data were also obtained during Hurricane ALICIA (1983), in support of HRD's land-based radar experiment, from National Weather Service (NWS) sites at Galveston and Corpus Christi, Texas. Described and illustrated are: (1) Research Aircraft Measurement System (RAMS) original data tape format [section 5.1]; (2) RFC standard data tape format [section 5.2]; (3) airborne radar data tape format [section 5.3]; (4) airborne Doppler radar system and data tape format [section 5.4]; (5) land-based radar system and data tape format [section 5.5]; (6) Knollenberg forward scattering spectrometer probe (FSSP) and data tape format [section 5.6]; and (7) Knollenberg two-dimensional (2-D) probe and data tape format [section 5.7].

Table 2. Official best- (storm) tracks for NHRL missions: 1982

Storm	Mission	Figure	No. missions	Mission ident.[5]	Location
ALBERTO	Recon/Res[1]	16	1 of 1	820604I[6]	Gulf Mex
DEBBY	Recon/Res	16	1 of 5	820913H[6]	Atlantic
	ODW[2]/PBL[3]/DOP[4]		2 of 5	820914I	
	ODW		3 of 5	820914H	
	ODW		4 of 5	820915I	
	ODW		5 of 5	820915H	
OLIVIA	ODW	24	1 of 4	820923I	E. Pacific
	ODW		2 of 4	820923H	
	ODW		3 of 4	820924H	
	ODW		4 of 4	820924I	

1. Recon/Res: Reconnaissance (NHC) and research mission objectives (NHRL).
2. ODW: Synoptic-flow (Omega-dropwindsonde) experiment.
3. PBL: Hurricane planetary boundary-layer experiment.
4. DOP: Airborne Doppler radar feasibility test.
5. Mission identification code: YrMoDaAcn, where: Yr = year (82 = 1982); Mo = month (09 = September); Ac = aircraft (see designation for H and I below); n = used when multiple missions flown on the same date.
6. H and I are, respectively, NOAA/WP-3D aircraft 42 and 43.

Table 3. Official best- (storm) tracks for HRD missions: 1983[1]

Storm	Mission	Figure	No. missions	Mission ident.	Location
ALICIA	LTM/Recon/Res	29	1 of 5	830816H	Gulf Mex
	LTM/VE		2 of 5	830817I1	
	LTM/VE		3 of 5	830817H	
	LTM/VE		4 of 5	830817I2	
	LTM/VE		5 of 5	830818H	
BARRY	LTM/VE/Recon/Res	29	1 of 2	830823I	Atlantic
	LTM/VE/Recon/Res		2 of 2	830825H	
DEAN	ASI/Recon/Res	29	1 of 3	830928I	Atlantic
	Recon/Res/LTM		2 of 3	830929H1	
	Recon/Res/LTM		3 of 3	830929I	
RAYMOND	CDYN/RB	41	1 of 2	831010I	E. Pacific
	CDYN/RB		2 of 2	831010H	
TICO	CDYN/RB/WB	41	1 of 2	831013I	E. Pacific
	CDYN/RB/WB		2 of 2	831013H	

1. Refer to notes at the bottoms of tables 1 and 2.

Table 4. Satellite photos corresponding to the approximate midtime of referenced NHRL missions: 1982[1]

Storm	Mission	Figure	Mission ident.	Location	Satellite
ALBERTO	Recon/Res	17	820604I	Gulf Mex	GOES-EAST
DEBBY	Recon/Res	18	820913H	Atlantic	GOES-EAST
	ODW/PBL/DOP	19	820914I		
	ODW	21	820914H		
	ODW	22	820915I		
	ODW	23	820915H		
OLIVIA	ODW	25	820923I	E. Pacific	GOES-WEST
	ODW	26	820923H		
	ODW	27	820924H		
	ODW	28	820924I		

1. Refer to notes at the bottoms of tables 1 and 2.

Table 5. Satellite photos corresponding to the approximate midtime of referenced HRD missions: 1983[1]

Storm	Mission	Figure	Mission ident.	Location	Satellite
ALICIA	LTM/Recon/Res	30	830816H	Gulf Mex	GOES-EAST
	LTM/VE	31	830817I1		
	LTM/VE	32	830817H		
	LTM/VE	34	830817I2		
	LTM/VE	35	830818H		
BARRY	Recon/Res/LTM/VE	36	830823I	Atlantic	GOES-EAST
	Recon/Res/LTM/VE	37	830825H		
DEAN	ASI/Recon/Res	38	830928I	Atlantic	GOES-EAST
	LTM/Recon/Res	39	830929H1		
	LTM/Recon/Res	40	830929I		
RAYMOND	CDYN/RB	42	831010I	E. Pacific	GOES-WEST
	CDYN/RB	43	831010H		
TICO	CDYN/RB/WB	44	831013I	E. Pacific	GOES-WEST
	CDYN/RB/WB	45	831013H		

1. Refer to notes at the bottoms of tables 1 and 2.

5.1 RAMS Original Data Tape Format

Airborne meteorological data collected with the NOAA WP-3D aircraft are recorded, in raw digital form, on a seven-track magnetic tape, in the RAMS format. The information is coded binary, with the exception of WORDS 3, 4, and 5 [Fig. 6], which are in ASCII format. Either 556- or 800-BPI tape density is used, with 152 words per record, 10 records per BLOCK, and recorded at a rate of 1 record per second.

5.2 RFC Standard Data Tape Format

The RFC Standard Tape provides the user with data tapes that are common to both NOAA WP-3D aircraft. (Its major function, to provide a data tape with a common format, was more critical in past years when the RFC operated aircraft with different types of digital recording systems.) Parameters on the RFC standard tape are already converted from raw digital values to engineering units. This tape is developed by a process that uses original aircraft tape data as input to produce a "convert" or standard tape. Two records are generated as output on the RFC standard tape for each original (input) record. The first of these records is simply a duplicate of the original (input) record, with 16-bit WORDS (no alterations). The second record on the output tape contains the original parameters and appropriately derived meteorological parameters in engineering units. The RFC standard tape format is shown in Fig. 7.

5.3 Airborne Radar Data Tape Format

The RFC radar data tape is formatted in fixed record lengths [Fig. 8]. Each record begins with "header data," which include: radar parameters, aircraft orientation, and time (when the data were acquired). Header data are followed by 10 data acquisitions (WORDS 17 through 1303), which correspond to half-beam widths and contain azimuth and range bin information. Lower fuselage (LF), nose (N), and tail (T) radar data may be recorded on the NOAA WP-3D aircraft. The tail radar (RHI) is also used for the airborne Doppler radar system on one of the NOAA aircraft [section 5.4].

5.4 Airborne Doppler Radar System and Data Tape Format

The airborne Doppler radar is designed to measure the component motion of reflective particles in the atmosphere toward or away from the aircraft. The X-band system on the NOAA aircraft uses a magnetron transmitter. Its antenna is mounted in the tail of one of the NOAA WP-3D aircraft. The antenna scans about the longitudinal axis of the aircraft perpendicular to the aircraft's ground track. This scanning strategy is designed to minimize the contamination (caused by the aircraft's motion) of the Doppler return signal. At a (typical) ground speed of 140 m s^{-1} and an antenna rotation rate of 10 rpm, an effective horizontal resolution of approximately 1 km is obtained. The motion of the aircraft, combined with the rotation of the antenna, produces a three-dimensional volume scan in space.

Word		Parameter (units: all data in count units)
1		WORDS/RECORD (152; 120 before 1979)
2		AIRCRAFT NUMBER
3		TABLE NAME (T.)
4		TABLE NAME (1H)
5		TABLE NAME (UR)
6		YEAR/MONTH
7		DAY/HOUR
8		MINUTE/SECOND
9		EVENT SWITCHES
10		EVENT SWITCHES
11	ONE	DATE
12		HOUR/MINUTE
13		SECOND
14		LATITUDE
15		LATITUDE
16		LONGITUDE
17		LONGITUDE
18		GROUND SPEED N/S
19		GROUND SPEED E/W
20		TRUE AIRCRAFT HEADING
21		PITCH ANGLE
22		ROLL ANGLE
23		POWER DROPOUT
24		ONE (Omega Navigation Equipment) STATUS
25		ONE STATUS
26		ONE STATUS
27		ONE STATUS
28		DOPPLER STATUS
29		INE 1 STATUS
30		INE 2 STATUS
31		DOPPLER GROUND SPEED
32		DOPPLER DRIFT
33		CHECK SUM
34	INE 1	PRESSURE ALTITUDE
35		LATITUDE
36		LATITUDE
37		LONGITUDE
38		LONGITUDE
39		GROUND SPEED N/S
40		GROUND SPEED E/W
41		VERTICAL SPEED
42		DRIFT ANGLE
43		TRUE AIRCRAFT HEADING
44		PITCH ANGLE
45		ROLL ANGLE

Fig. 6. RAMS original data tape format.

Word		Parameter (units: all data in count units)
46	INE 2	PRESSURE ALTITUDE
47		LATITUDE
48		LATITUDE
49		LONGITUDE
50		LONGITUDE
51		GROUND SPEED N/S
52		GROUND SPEED E/W
53		VERTICAL SPEED
54		DRIFT ANGLE
55		TRUE AIRCRAFT HEADING
56		PITCH ANGLE
57		ROLL ANGLE
58		INDICATED DYNAMIC PRESSURE
59		INDICATED STATIC PRESSURE
60		RADAR ALTITUDE
61-70		ICE PARTICLE COUNT
71		TOTAL TEMPERATURE 1
72		TOTAL TEMPERATURE 2
73		DEW (FROST) POINT
74		ATTACK PRESSURE
75		DYNAMIC ATTACK PRESSURE
76		SLIP PRESSURE
77		DYNAMIC SLIP PRESSURE
78		JOHNSON-WILLIAMS CLOUD WATER
79		SPARE
80		RADIOMETER DOWN
81-84		ADC #1 CHANNELS 11-14
85		VERTICAL ACCELERATION (VAC)
86		VERTICAL ACCELERATION
87-95		ADC #1 CHANNELS 17-25
96		AXBT TEMPERATURE 1
97		AXBT TEMPERATURE 2
98		AXBT TEMPERATURE 3
99-102		ADC #1 CHANNELS 29, 00
103-134		ADC #2 CHANNELS 01-31, 00
135-144		CLOUD PHYSICS STATUS
145		DAY
146		HOUR
147		MINUTE
148		SECOND
149-152		STATUS

Fig. 6 (continued). RAMS original data tape format.

Word	Parameter (units)
1	TYPE RECORD (5)
2	WORDS/RECORD
3	HOURS
4	MINUTES
5	SECONDS
6	RECORD COUNT
7	RECORD COUNT > 32767
8	SWITCHES
9	SWITCHES
10	ERROR FLAGS
11	ERROR FLAGS
12	LATITUDE (deg)
13	LATITUDE (min)
14	LONGITUDE (deg)
15	LONGITUDE (min)
16	RADAR ALTITUDE (m)
17	STATIC PRESSURE (mb)
18	TEMPERATURE (deg C)
19	FROST POINT (deg C)
20	RADIOMETER [DOWN] TEMPERATURE (deg C)
21	RADIOMETER [SIDE] TEMPERATURE CO_2 (deg C)
22	GROUND SPEED (m s^{-1})
23	TRUE AIRSPEED (m s^{-1})
24	INTEGRATED VERTICAL ACCELERATION (m s^{-1})
25	TRACK (deg)
26	TRUE AIRCRAFT HEADING (deg)
27	PITCH ANGLE (deg)
28	ROLL ANGLE (deg)
29	ATTACK ANGLE (deg)
30	SLIP ANGLE (deg)
31	LIQUID WATER CONTENT (g m^{-3})
32	DYNAMIC PRESSURE (mb)
33	DEW POINT (deg C)
34	BLANK
35	BLANK
36	BLANK
37	BLANK
38	BLANK
39	BLANK
40	GEOPOTENTIAL ALTITUDE (gpm)
41	PRESSURE ALTITUDE (m)
42	D-VALUE (m)
43	HEIGHT OF THE 500-mb STANDARD LEVEL (gpm)
44	SURFACE PRESSURE (mb)

Fig. 7. RFC standard data tape format.

Word	Parameter (units)
45	RELATIVE HUMIDITY (%)
46	VIRTUAL TEMPERATURE (deg K)
47	VERTICAL AIRSPEED (m s^{-1})
48	RATIO SPECIFIC HEAT (dimensionless)
49	MACH NUMBER (dimensionless)
50	DRIFT ANGLE (deg)
51	GROUND SPEED E/W (m s^{-1})
52	GROUND SPEED N/S (m s^{-1})
53	TRUE AIRSPEED E/W (m s^{-1})
54	TRUE AIRSPEED N/S (m s^{-1})
55	WIND SPEED E/W (m s^{-1})
56	WIND SPEED N/S (m s^{-1})
57	VERTICAL WIND SPEED (m s^{-1})
58	WIND SPEED (m s^{-1})
59	WIND DIRECTION (deg)
60	SURFACE TEMPERATURE (deg C)
61	VAPOR PRESSURE (mb)
62	MIXING RATIO (g kg^{-1})
63	POTENTIAL TEMPERATURE (deg K)
64	EQUIVALENT POTENTIAL TEMPERATURE (deg K)
65	E/W AVERAGE WIND SPEED (m s^{-1})
66	N/S AVERAGE WIND SPEED (m s^{-1})
67	AVERAGE WIND SPEED (m s^{-1})
68	AVERAGE WIND DIRECTION (deg)
69	LATITUDE CORRECTION (min of latitude)
70	LONGITUDE CORRECTION (min of longitude)
71	WIND AVERAGE (SECONDS) [averaging period (# of sec)]
72	AXBT CHANNEL 1
73	AXBT CHANNEL 2
74	AXBT CHANNEL 3
75	NAVIGATION UNIT USED (INE 1, INE 2)
76	TEMPERATURE UNIT USED (TEMP 1, TEMP 2)
77	BLANK
78	STORM LATITUDE (deg)
79	STORM LATITUDE (min)
80	STORM LONGITUDE (deg)
81	STORM LONGITUDE (min)
82	VIRTUAL LATITUDE (km)
83	VIRTUAL LONGITUDE (km)
84	STORM DISTANCE (km)
85	STORM SPEED (m s^{-1})
86	STORM TRACK (deg)
87	RADIAL WIND (m s^{-1})
88	TANGENTIAL WIND (m s^{-1})
89	RELATIVE RADIAL WIND (m s^{-1})
90	RELATIVE TANGENTIAL WIND (m s^{-1})
91	RELATIVE WIND SPEED (m s^{-1})
92	RELATIVE WIND DIRECTION (deg)

Fig. 7 (continued). RFC standard data tape format.

Word	Parameter (units)
93	REFERENCE PRESSURE (mb)
94	REFERENCE HEIGHT (m)
95	REFERENCE TEMPERATURE (deg C)
96	ADJUSTED TEMPERATURE (deg C)
97	ADJUSTED DEW POINT (deg C)
98	ADJUSTED D-VALUE (m)
99	ADJUSTED EQUIVALENT POTENTIAL TEMPERATURE (deg k)
100	BLANK
101	BLANK
102	BLANK
103	BLANK
104	BLANK
105	BLANK
106	BLANK

Fig. 7 (continued). RFC standard data tape format.

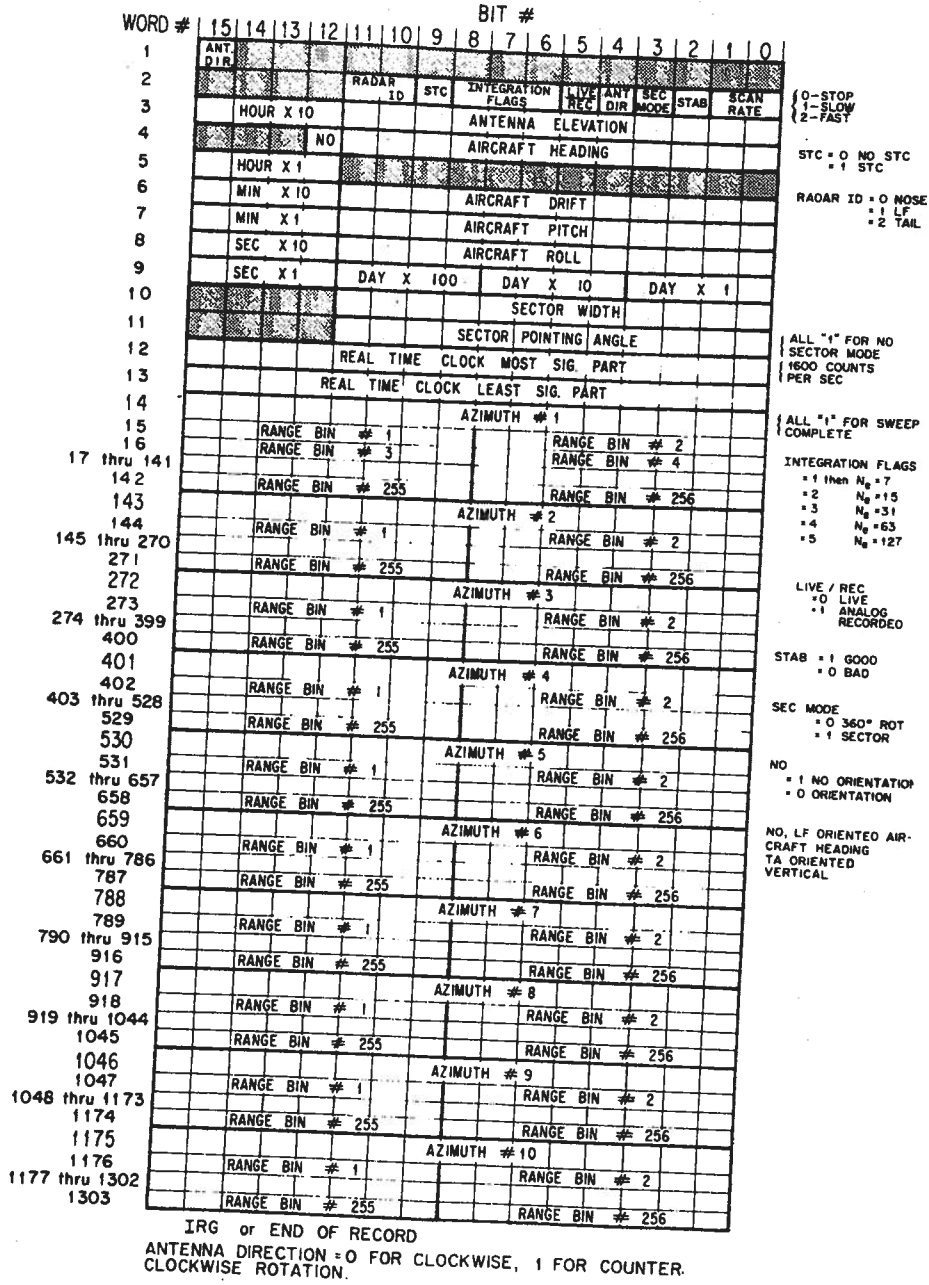


Fig. 8. Airborne radar data tape format.

There are 256 range gates with selectable spacing of 150 or 300 m. The mean Doppler velocity within each gate is estimated by the Doppler processor's use of a "pulse-pair" technique. The mean Doppler velocity in each range gate, antenna positioning parameters, and other information provided by airborne inertial navigation equipment (INE), are written on a 9-track magnetic tape at a rate corresponding to the number of pulses integrated (nominally 32 or 64) divided by the pulse repetition frequency (1600). Fig. 9 depicts the airborne Doppler radar data tape format.

Reflectivity is processed by a separate data recording system that is not affected by the range and integration options of the Doppler processor. A real-time "range versus velocity" display is available on the aircraft to monitor the data gathering process.

To produce an analysis of the three-dimensional wind field over mesoscale areas (typically 50 km by 50 km), a specialized flight track must be used. This flight track enables the Doppler to make two observations of a common point in space from two nearly orthogonal directions. This method is known as the "psuedo-dual-Doppler-technique." The flight track consists of an L-shaped pattern, with (approximately) 50-km legs. An extensive postflight data processing effort is required to derive the horizontal wind field and remove biases from the analysis of vertical velocity that are caused, in part, by particle terminal fall speeds and/or improper antenna behavior. Fig. 10 illustrates an analysis of postprocessed airborne Doppler radar data using an L-shaped pattern and the psuedo-dual-Doppler technique.

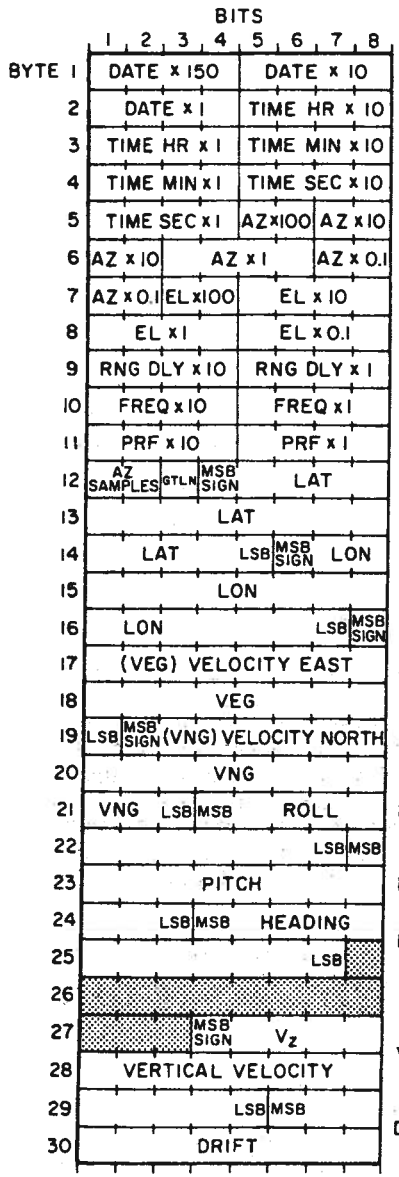
5.5 Land-Based Radar System and Data Tape Format

During the 1983 hurricane season, HRD and the National Weather Service Training Center (NWSTC) deployed land-based radar teams to NWS sites at Galveston (GLS) and Corpus Christi (CRP), Texas, respectively, to record digital radar data in advance of the landfall of Hurricane Alicia. The primary goal of this project is to accumulate digitized radar data sets in the immediate vicinity of landfalling hurricanes. Such data are used by HRD scientists to: (a) document and study the structural evolution of landfalling hurricanes; (b) determine storm-associated rainfall rates over land during and after landfall; and (c) conduct intercomparison and verification analyses of airborne and land-based radar data.

Both HRD's and NWSTC's land-based radar recording systems are designed to "plug-in" to NWS/WSR-57 (or other NWS) radar systems. Field operations at NWS sites, under storm/hurricane conditions, are conducted on a noninterference basis.

The land-based radar recording system used by HRD is composed of: (1) a controller, designed by engineers at RFC (OAO) and not available commercially; (2) a standard NWS digital video integrator and processor (DVIP) unit; (3) a Kennedy 9800 9-track, variable density tape drive, 9217B buffer memory, and 9218 format control. The recording system uses the raw received radar signal, digitizes this information through the DVIP, and records the digitized data on magnetic tape for subsequent analysis. The data tape format for this system is shown in Fig. 11.

ORIGINAL AIRBORNE P-3 DOPPLER TAPE FORMAT



AZ - AZIMUTH 0° to 360°

EL - ELEVATION +25° to -25°

RNG DLY - RANGE DELAY (KM)

FREQ - FREQUENCY [9300 + (x10) + (x1) MHz]

PRF - PULSE REPETITION FREQUENCY [1500 + (x10) + (x1

AZ SAMPLES - # OF AZIMUTH SAMPLES
00 = 32 10 = 128
01 = 64 11 = 256

GTLN - GATE LENGTH 0 = 150 m 1 = 300 m

LAT - LATITUDE $[PI/2^{18}]$

LON - LONGITUDE $[PI/2^{18}]$

VEG - EAST-WEST GROUND SPEED $[0.257732\ ms^{-1}]$

VNG - NORTH-SOUTH GROUND SPEED $[0.257732\ ms^{-1}]$

ROLL - ROLL ANGLE $[5.493164 \times 10^{-3}\ DEG]$

PITCH - PITCH ANGLE $[5.493164 \times 10^{-3}\ DEG]$

HEADING $[5.493164 \times 10^{-3}\ DEG]$

VERTICAL VELOCITY $[0.00953\ ms^{-1}]$

DRIFT $[5.493164 \times 10^{-3}\ DEG]$

Fig. 9. Airborne Doppler radar data tape format.

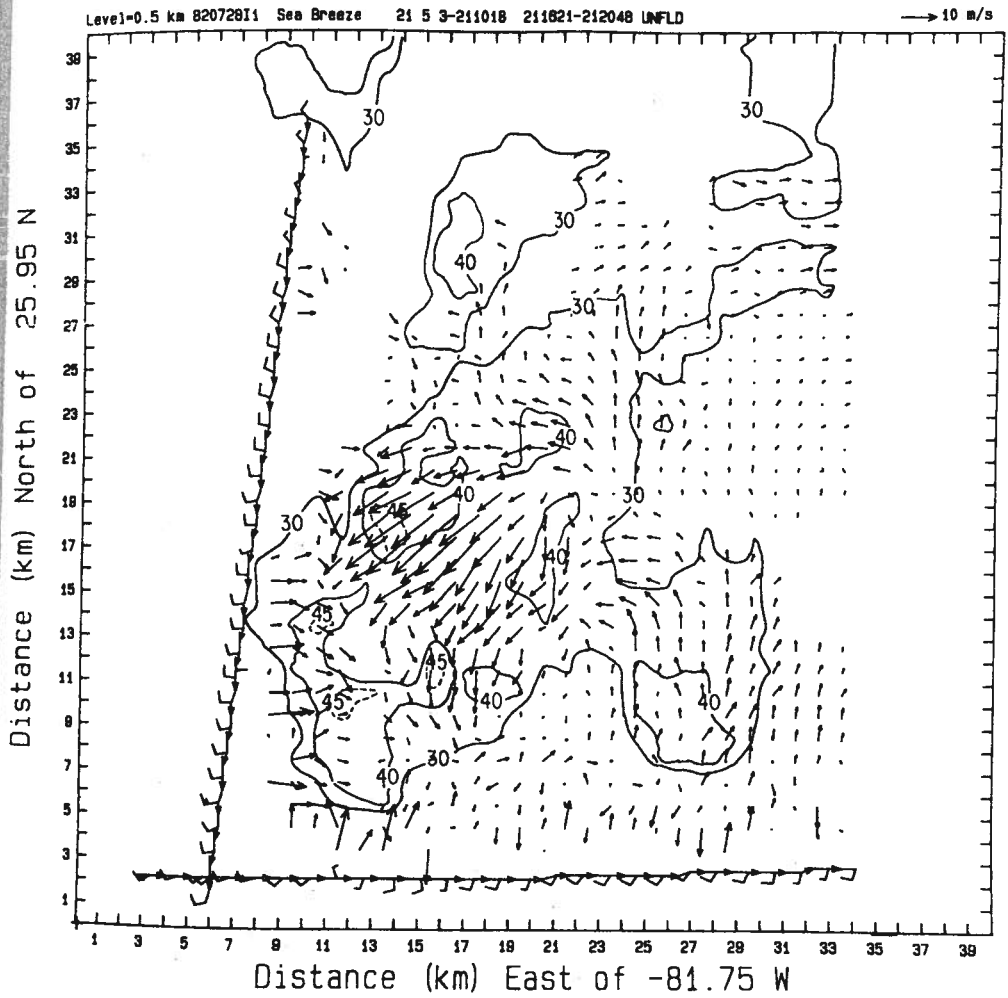


Fig. 10. Horizontal wind field analysis from postprocessed airborne Doppler radar data. The wind field was composited using the psuedo-dual-Doppler technique.

LOGICAL RECORD ADDRESS IN BLOCK

Record (ray)	Word (byte)	Comments
1 (1)	0 (0)	Range bins from 1-450 km +16 header words
2 (2)	241 (482)	Range bins from 1-450 km +16 header words
3 (3)	482 (964)	Range bins from 1-450 km +16 header words
4 (4)	723 (1446)	Range bins from 1-450 km +16 header words

Notes:

1) Tapes: 9-track/1600 bpi.

2) Physical record:

   (a) 1928 8-bit bytes per physical record (block);

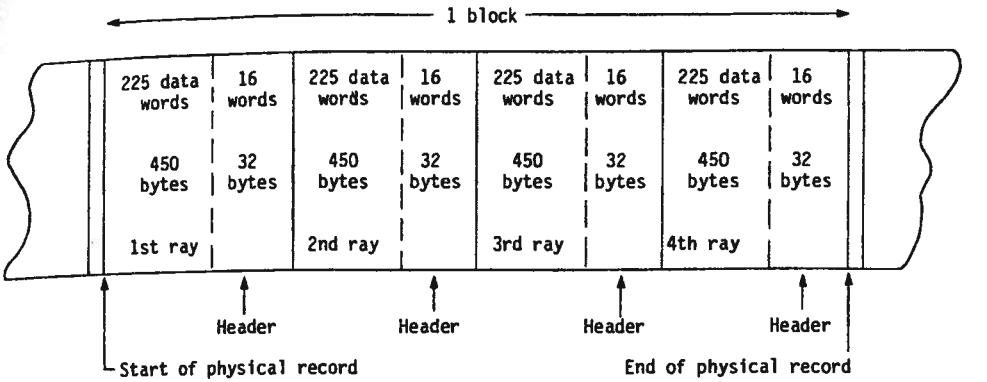
   (b) 4 logical records (rays) per physical record.

3) Ray: each ray contains 225 + 16 words (450 + 32 bytes).

4) Range bin data: packed 2 values per word where each bin is 1 km in range.

5) Data values: coded 0-255 machine numbers.

Fig. 11. HRD's land-based radar data tape format.



Header words are also packed as follows (only first 4 words used):

	BYTE															
	High								Low							
	Bits															
Word	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
1	10's digit hr.				1's digit hr.				10's digit min.				1's digit min.			
2	10's digit sec.				1's digit sec.				.1's digit sec.				.01's digit sec.			
3	100's digit az.				10's digit az.				1's digit az.				.1's digit az.			
4	All Bits On				10's digit elev.				1's digit elev.				.1's digit elev.			
5-16					ALL BITS ARE ON											

Fig. 11 (continued). HRD's land-based radar data tape format.

The digitized data, stored on magnetic tape during field operations, are then computer-processed and plotted at HRD. A black-and-white (dot-matrix) plot of data from Hurricane Alicia is shown in Fig. 12.

The system used by NWSTC was engineered and built by Enterprise Electronics. Its operational concept is to record the DVIP output, antenna information and specified header data from an operating NWS/WSR-74 radar in digital form on 9-track magnetic tape [Fig. 13]. This system consists of: (1) a read/write recorder (with Kennedy Model 9000 tape transport and Model 9217 formatter); (2) an electronic interface that allows the recording of data from NWS/WSR-57 radars that are not equipped with an isolation distribution amplifier (IDA); (3) a Kavouras, Inc., manufactured system to convert serial radar information received from an IDA to parallel information that emulates the NWS/WSR-57 radar DVIP output.

Typically, a poststorm calibration of each radar receiver that was used is conducted. This step is vital to the quantitative uses of all data recorded during the storm's passage. The calibration procedure requires that a signal of known strength (provided by a signal generator) be injected into the radar receiver. The receiver output power is monitored and recorded on the digital tape used to collect the storm data.

5.6 Knollenberg Forward Scattering Spectrometer Probe and Data Tape Format

The Knollenberg forward scattering spectrometer probe, a cloud physics instrument designed to measure cloud droplet sizes over the range of 0.5 to 45.0 μm, is mounted on the NOAA aircraft (under the wing tips) to insure a free flow of droplets through the device's sampling volume. The FSSP measures droplets in the following intervals: 0.5 to 7.5 μm; 1.0 to 15.0 μm; 2.0 to 30.0 μm; and 3.0 to 45.0 μm. The physical principle of the FSSP's operation involves the detection of a laser light source after it has been scattered by the droplets that pass through the sampling volume. Droplet size information thus obtained is recorded on magnetic tape in the format given by Fig. 14.

5.7 Knollenberg Two-Dimensional Probe and Data Tape Format

The Knollenberg two-dimensional probe is an imaging device used to measure precipitation-sized particles. It operates by shining a laser source through a series of lenses onto a photodiode array. As particles pass through the sampling volume, they intercept this light, producing diode shading. Diodes that remain illuminated are unshaded. The corresponding diode-status is, then, shaded (coded as 0) or unshaded (coded as 1). The diode-status is sampled very rapidly (in time), so that the two-dimensional images that are formed produce round images from round particles that pass through the sampling volume. The status of the diode array is recorded on magnetic tape in the format shown in Fig. 15.

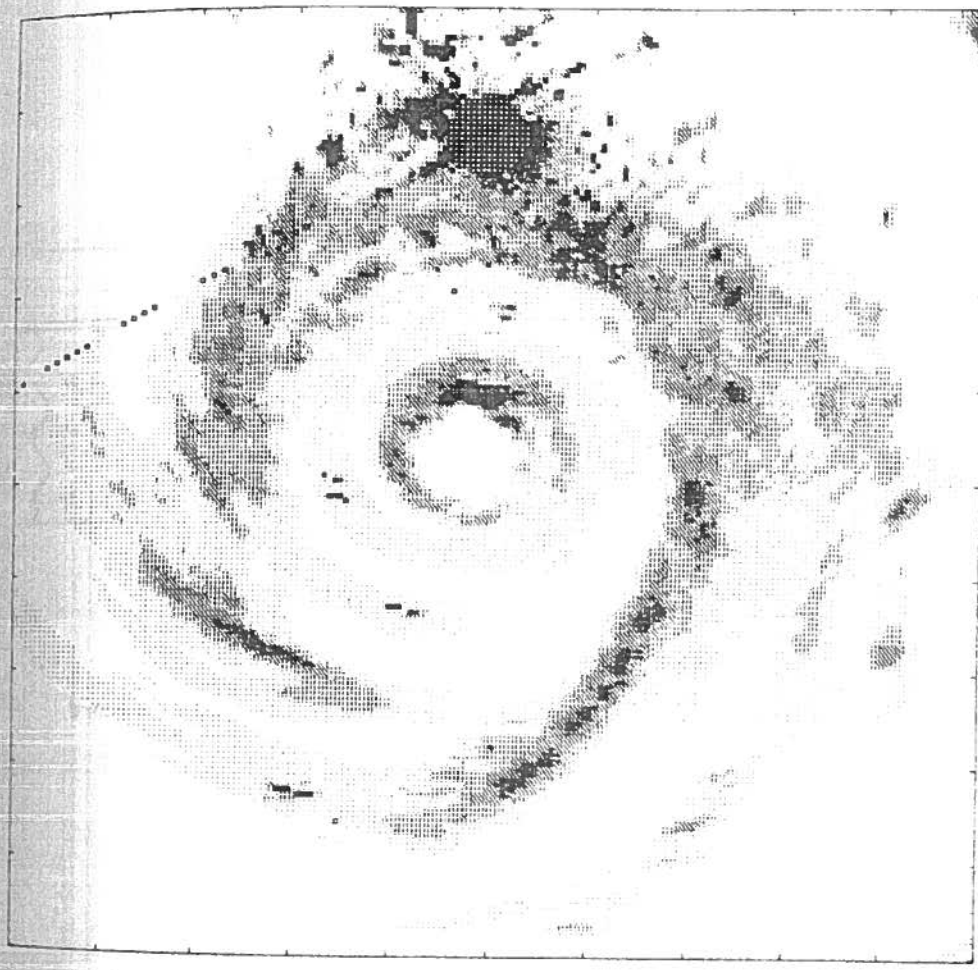
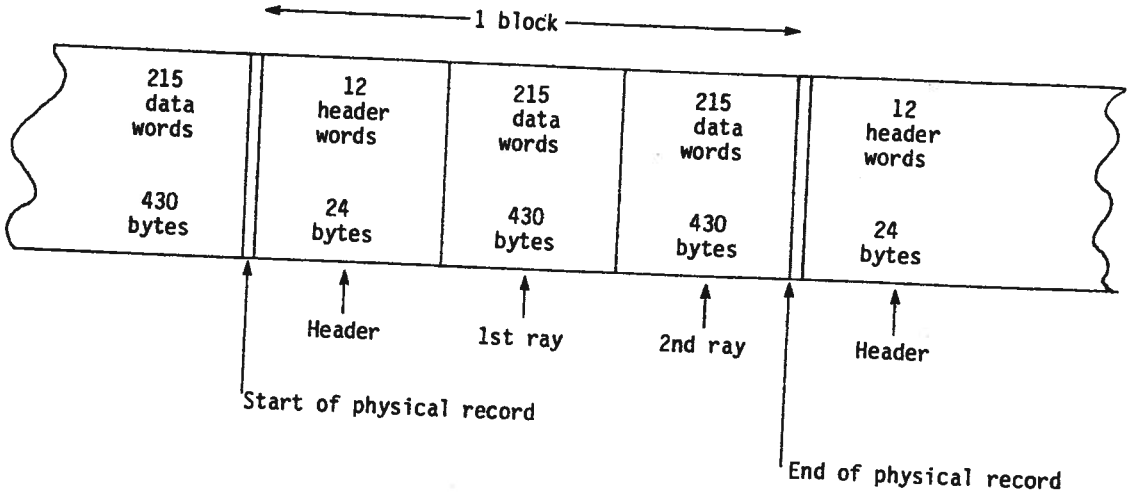


Fig. 12. Hurricane ALICIA: Reflectivity data from the NWS/WSR-57 radar at GLS, at 015515 GMT on 18 August 1983. The domain of the display is 200 km by 200 km and is centered on the hurricane. North is at the top center of the figure; the GLS radar is slightly to the left of center at the top of the figure.



Notes:

1) Original tapes: 9-track/800 bpi.

2) Copied tapes: 9-track/1600 bpi.

3) Physical record:

   (a) 884 bytes per physical record (block);

   (b) 442 words per physical record (block).

4) Ray: each block contains 2 rays + 1 header.

Fig. 13. NWSTC's land-based radar tape format.

Each block contains 12 header words as follows:

	BYTE	
	High	Low

Word	Bits 15 14 13 12 11 10 09 08	Bits 07 06 05 04 03 02 01 00
1	100's digit of day	10's digit of day
2	1's digit of day	10's digit of hour
3	1's digit of hour	10's digit of minute
4	1's digit of minute	10's digit of second
5	1's digit of second	1st digit of location
6	2nd digit of location	3rd digit of location
7	Wavelength	Delta azimuth (1^{o})
8	Range bin length (km)	Integration constant
9	Rate error (?)	Parity error (?)
10	100's digit of starting azimuth	10's digit of azimuth
11	1's digit of azimuth	10's digit of elevation
12	1's digit of elevation	.1's digit of elevation

Fig. 13 (continued). NWSTC's land-based radar tape format.

Notes:

1) Day: Julian date (1-356).

2) Location: 3 character ASCII code.

3) Wavelength: 1 = 5 cm; 2 = 10 cm.

4) Integration constant: 1 = 15 pulse; 2 = 31 pulse.

5) Azimuth of integration (block): azimuth of second ray on block is starting azimuth + delta azimuth ($+1^{o}$ or $+2^{o}$).

6) 2-215 word logical records containing the 2 rays of reflectivity data:

   (a) Each ray contains 430 range bins of estimated mean returned power ($\overline{P}_r$) from the integrator packed 2 per word, where each estimate of $\overline{P}_r$ is coded in a number between 0 and 255.

   (b) Each range bin is separated by the range bin length defined in the header (typically 1 km).

   (c) The coded values of $\overline{P}_r$ can be converted to equivalent reflectivity factor (Z_e) using the calibration to $\overline{P}_r$ in dBm and the radar equation to get Z_e in dBZ.

Fig. 13 (continued). NWSTC's land-based radar tape format.

Word	Parameter
1	MINUTES * 100 + SECONDS
2	MILLISECONDS FSSP RANGE (Bits 0 through 3)
3	YEAR * 100 + MONTH
4	DAY * 100 + HOUR
	Words 1 through 4 are nonrepeating and BCD coded
5	UNUSED
6	FSSP RANGE BITS 0-3 INCLUSIVE
7	UNUSED
.	"
.	"
.	"
18	UNUSED
19	2-D CLOCKING % * 100
20	FSSP A CHANNEL 1 COUNTS
.	"
.	"
.	"
34	FSSP A CHANNEL 15 COUNTS
35	2-D C PROBE OVERLOAD % * 100
36	2-D P PROBE OVERLOAD % * 100
37	2-D C TOTAL COUNTS
38	2-D P TOTAL COUNTS
39	UNUSED
.	"
.	"
.	"
50	UNUSED
51	FSSP B TOTAL COUNTS
52	FSSP B CHANNEL 1 COUNTS
.	"
.	"
.	"
66	FSSP B CHANNEL 15 COUNTS
67	2-D C DIODE 1 VOLTS * 1000
68	2-D P DIODE 1 VOLTS * 1000
69	UNUSED
.	"
.	"
.	"
82	UNUSED
83	2-D CLOCKING % * 100
84	FSSP A CHANNEL 1 COUNTS
.	"
.	"
.	"
98	FSSP A CHANNEL 15 COUNTS

Fig. 14. Knollenberg FSSP data tape format.

Word	Parameter
99	2-D C DIODE 32 VOLTS * 1000
100	2-D P DIODE 32 VOLTS * 1000
101	UNUSED
.	"
.	"
.	"
114	UNUSED
115	FSSP B TOTAL COUNTS
116	FSSP B CHANNEL 1 COUNTS
.	"
.	"
.	"
130	FSSP B CHANNEL 15 COUNTS
131	2-D C -15 VOLT SUPPLY
132	2-D P -15 VOLT SUPPLY
133	UNUSED
.	"
.	"
.	"
146	UNUSED
147	2-D CLOCKING % * 100
148	FSSP A CHANNEL 1 COUNTS
.	"
.	"
.	"
162	FSSP A CHANNEL 15 COUNTS
163	2-D C -12 VOLT SUPPLY
164	2-D P -12 VOLT SUPPLY
165	UNUSED
.	"
.	"
.	"
178	UNUSED
179	FSSP B TOTAL COUNTS
180	FSSP B CHANNEL 1 COUNTS
.	"
.	"
.	"
194	FSSP B CHANNEL 15 COUNTS
195	2-D C +5 VOLT A SUPPLY
196	2-D P +5 VOLT A SUPPLY
197	UNUSED
.	"
.	"
.	"
210	UNUSED

Fig. 14 (continued). Knollenberg FSSP data tape format.

Word	Parameter
211	2-D C CLOCKING % * 100
212	FSSP A CHANNEL 1 COUNTS
.	"
.	"
.	"
226	FSSP A CHANNEL 15 COUNTS
227	2-D C +5 VOLT B SUPPLY
228	2-D P +5 VOLT B SUPPLY
229	UNUSED
.	"
.	"
.	"
242	UNUSED
243	FSSP B TOTAL COUNTS
244	FSSP B CHANNEL 1 COUNTS
.	"
.	"
.	"
258	FSSP B CHANNEL 15 COUNTS
259	2-D C +15 VOLT SUPPLY
260	2-D P +15 VOLT SUPPLY
261	UNUSED
.	"
.	"
.	"
274	UNUSED
275	2-D CLOCKING % * 100
276	FSSP A CHANNEL 1 COUNTS
.	"
.	"
.	"
290	FSSP A CHANNEL 15 COUNTS
291	2-D C TEMPERATURE
292	2-D P TEMPERATURE
293	UNUSED
.	"
.	"
.	"
306	UNUSED
307	FSSP B TOTAL COUNTS
308	FSSP B CHANNEL 1 COUNTS
.	"
.	"
.	"
322	FSSP B CHANNEL 15 COUNTS

Fig. 14 (continued). Knollenberg FSSP data tape format.

Word	Parameter
1	MINUTES (BCD) SECONDS (BCD)
2	MILLISECONDS (BCD) PROBE IDENTITY/OVERLOADING
3	2-D IMAGES AND TIME CODES
.	"
.	"
.	"
2050	2-D IMAGES AND TIME CODES

Fig. 15. Knollenberg 2-D probe data tape format.

6. Flight Log/Tape Log Form

Individual sets of research mission data (for NHRL in 1982 and HRD in 1983) are documented in section 8. The information contained on the flight and tape log forms is self-explanatory. The flight log portion of the form provides date, flight (mission) and aircraft identification, departure and arrival terminals (and corresponding GMT times), mission purpose(s), and mission pattern information. The tape log inventory (for each mission, as identified on the flight log portion of the form), provides information relative to the type of data tapes available (i.e., original, RFC standard, radar, Knollenberg), the number of such tapes and, when available, the "start" (from) and "stop" (to) times for the number of tapes in each category taken as a data set.

7. Equipment Status Form

The equipment status form serves as an indication (to the user) of "gross" system(s) operation during each specific mission. The statuses of major systems and their corresponding subsystems, when appropriate, are listed categorically as "up" (normal operation), "down" (not operating, or malfunctioning during the mission), or "not used" (system not in use, or not installed on the aircraft during the mission), and marked accordingly on this form. A "remarks" section is also provided for comments concerning the status of the equipment.

Table 6 provides (1) a breakdown of the items listed on mission equipment status forms; (2) parameters obtained from listed sensor/systems; and (3) remarks. Data that are not part of the so-called standard meteorological package are recorded on separate systems.

Tabl 6. Equipment status form breakdown

Sensor or system	Equip. status sheet code	Remarks/parameter
Navigation:		[Figs. 6 and 7]
Inertial navigation	INE 1	Time of day
	INE 2	Latitude
Omega navigation	ONE	Longitude
Doppler navigation	DOPL	Ground speed
		Heading
		Track
		Pitch
		Roll
		Vertical speed
		Drift
Radar system:		Separate recording system* [Fig. 8]
Nose	NOSE	240° horizontal scan
Lower fuselage	LF	360° horizontal scan
Tail	TA	360° vertical scan
Doppler	DOPL	360° vertical scan
Data system	DATA SYSTEM	Computer, recorder, display
RAMS data system:	RAMS	Computer, recorder, display: WP-3D [Fig. 6]
Total temperature	TOT. TEMP. 1	Ambient temperature (System #1)
	TOT. TEMP. 2	Ambient temperature (System #2)
Dew point	DEW POINT	Dew (frost) point temperature
Attack angle	ATTACK ANGLE	Attack pressure
Slip angle	SLIP ANGLE	Slip pressure
Absolute pressure	ABS. PRESSURE	Ambient pressure
Differential pressure	DIFF. PRESSURE	Dynamic pressure
Radar altimeter	RADAR ALT.	True (altimeter) altitude
Liquid water	JOHNSON-WILLIAMS	Cloud liquid water
Knollenberg/cloud physics system:		Separate recording system(s) [Figs. 14 and 15]
PMS		
	OAP-2 DP	Cloud droplet spectrum
	OAP-2 DC	Hydrometeor size spectrum
	FSSP-100	Small cloud droplet spectrum
	DATA SYSTEM	Computer, recorder, display

*In 1982, the option to record two of the three (NOSE, LF, and TA) radars on a single data tape existed. In 1983, only LF and TA radars were recorded on data tapes.

Table 6 (Continued). Equipment status form breakdown

Sensor or system	Equip. status sheet code	Remarks/parameter
Ice particle counter:	IPC	Ice particle counts (number)
Foil impactor:	FOIL	Separate recording system Hydrometeor-size spectrum
CO_2 radiometer:	CO_2 RADIOMETER	Air temperature (from CO_2 radiometer)
Microwave radiometer:	MICROWAVE RAD.	Microwave radiometer temperature
Surface radiometer:	SFC. RADIOMETER	Sea-surface temperature
Formvar replicator:	FORMVAR	Separate recording system Cloud particle replicator
Photography:		Separate recording system(s)
	FWD	Forward-looking 16 mm camera
	LS	Left-side-looking 16 mm camera
	RS	Right-side-looking 16 mm camera
	DWN	Downward-looking 16 mm camera
Bathythermograph:	AXBT TUBES/RECEIVERS	Ocean temperature
Omega dropwindsonde:	ODW	Separate recording system Launch mechanism and recorder/atmospheric sounding (temperature, pressure, humidity, wind)

Table 7. Data documented in section 8.1: 1982

Storm	Mission ident.	Best-track figure	Satellite figure	Flight/tape logs	Equipment status
ALBERTO	820604I	16	17	Yes/Yes	Yes
NEBBY	820913H	16	18	Yes/Yes	Yes
	820914I	16	19	Yes/Yes	Yes
	820914H	16	21	Yes/Yes	Yes
	820915I	16	22	Yes/Yes	Yes
	820915H	16	23	Yes/Yes	Yes
OLIVIA	820923I	24	25	Yes/Yes	Yes
	820923H	24	26	Yes/Yes	Yes
	820924H	24	27	Yes/Yes	Yes
	820924I	24	28	Yes/Yes	Yes

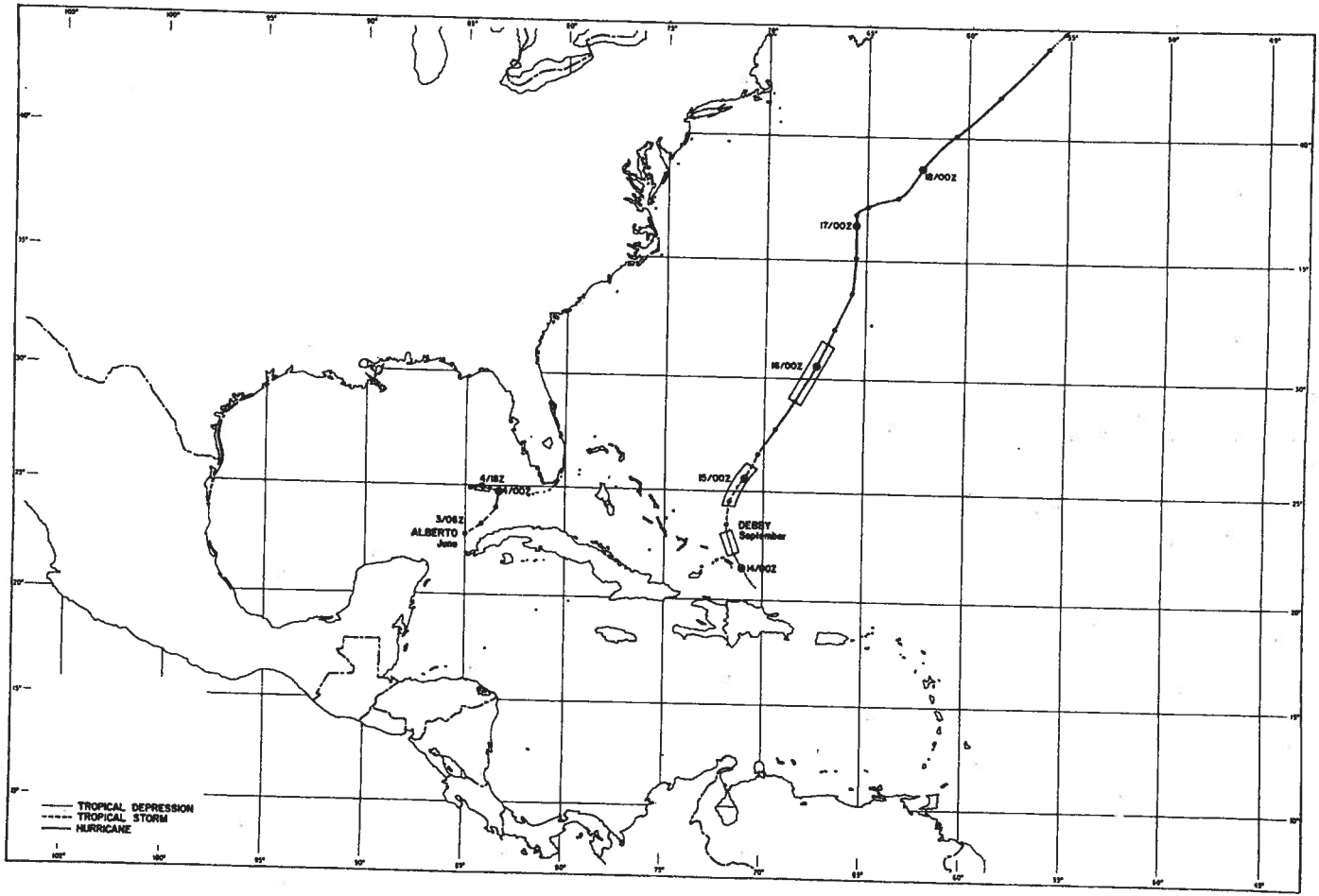


Fig. 16. Best-track plots for Atlantic storms investigated by NHRL during the 1982 hurricane season.

8. Individual Mission Data Catalog

8.1 1982 Missions

STORM NAME	DATE(S) FLOWN	MISSION(S) IDENT.	TYPE[2]	REMARKS[3]	FIGURES
ALBERTO	4 June 1982	820604I	R/R	Gulf Mex	16,17

Hurricane ALBERTO (2-6 June 1982): In late May, a tropical disturbance developed slowly over the northwest Caribbean and drifted westward over the Yucatan Peninsula. On 1 June, now an organized cloud system, the disturbance moved from the Yucatan Peninsula generally northeastward across the southeast Gulf of Mexico and became a tropical depression on 2 June. The depression intensified to hurricane strength on 3 June. Alberto was a hurricane for less than 12 h and never made landfall. Although gale-force winds and heavy rains were observed in the lower Florida Keys, the area sustained only minor damage. Flash flooding in western Cuba, where over 14 in (356 mm) of rain fell, caused 23 deaths and heavy crop damage. Alberto dissipated on 6 June. [Clark, 1982a,b; National Climatic Center, 1982a.]

2. R/R: Reconnaissance (NHC) and research (NHRL) mission objectives.
3. Gulf Mex: Gulf of Mexico.

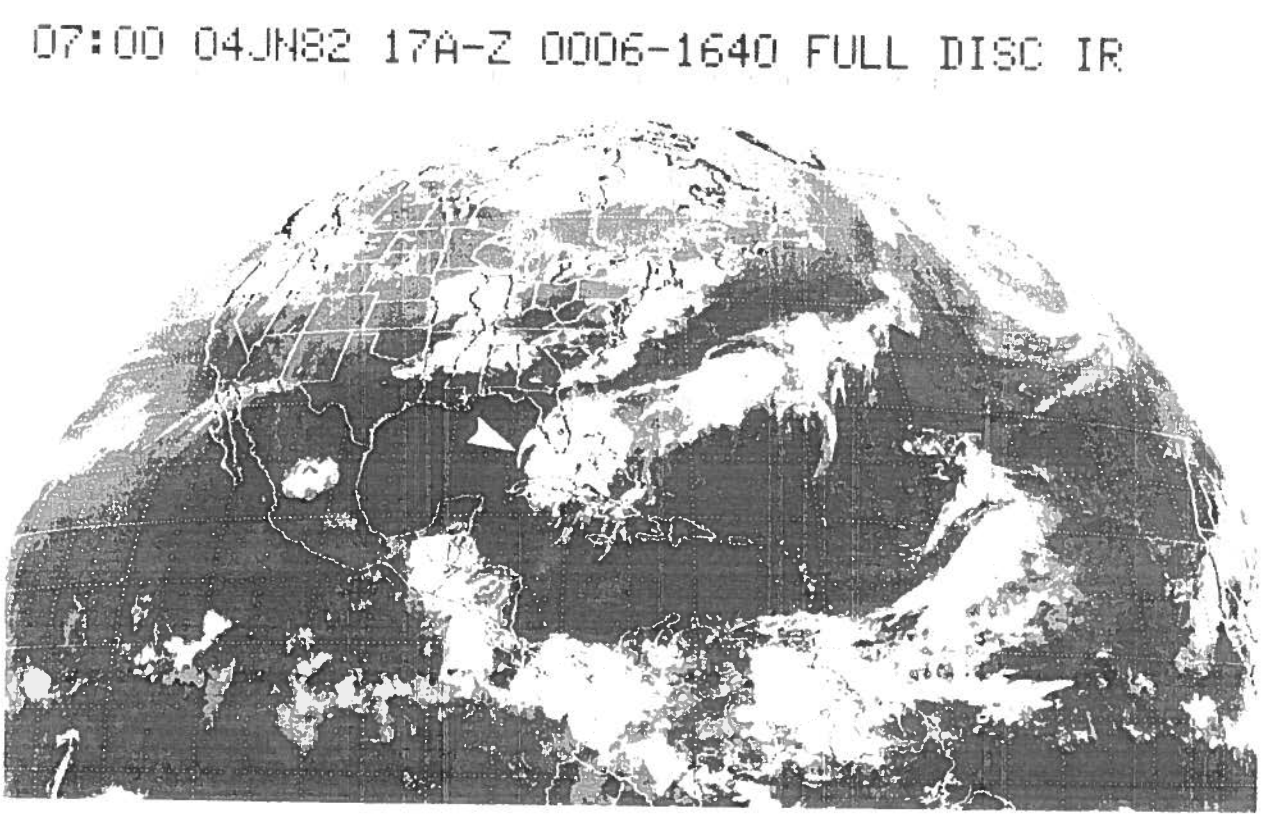


Fig. 17. ALBERTO (4 June 1982/0700 GMT) GOES-EAST/FULL DISC IR.

FLIGHT LOG

Date:	June 4, 1982
Flight Identification:	820604I
Aircraft:	WP-3D/N43RF
Departed:	Miami, Florida, at 04/0300 GMT
Arrived:	Miami, Florida, at 04/1050 GMT
Purpose:	Reconnaissance (NHC)/research (NHRL) - Hurricane ALBERTO
Pattern:	VI A (modified) at 1.5 K ft altitude.* Single-aircraft mission. Five fixes made between 04/0403 GMT and 04/0938 GMT.

FILM LOG

Camera	Roll	From [Day/Time (GMT)]	To [Day/Time (GMT)]

NO FILM TAKEN

*Ref. Hurricane Field Program Plan, 1982 - p. 35.

TAPE LOG: 820604I

Tape Type	Number	From [Day/Time (GMT)]	To [Day/Time (GMT)]
Radar	1/8	04/0334	04/0428
Radar	2/8	04/0428	04/0518
Radar	3/8	04/0518	04/0558
Radar	4/8	04/0558	04/0655
Radar	5/8	04/0655	04/0754
Radar	6/8	04/0755	04/0839
Radar	7/8	04/0840	04/0920
Radar	8/8	04/0920	04/1022

EQUIPMENT STATUS: 820604I

SYSTEM	STATUS /	UP	DOWN	NOT USED	REMARKS
NAV	INE 1	X			
	INE 2	X			
	ONE	X			
	OOPL	X			
RADAR	NOSE	X			
	LF			X	
	TAIL	X			
	DOPPLER			X	
	DATA SYSTEM	X			102250 GMT/Sys. failed
RAMS	DATA SYSTEM	X			
	TOTAL TEMP. 1	X			
	TOTAL TEMP. 2	X			
	DEW POINT	X			
	ATTACK ANGLE	X			
	SLIP ANGLE	X			
	ABS. PRESS.	X			
	DIFF. PRESS.	X			
	RADAR ALT.	X			
	J & W	X			
PMS	OAP 2DP			X	
	OAP 2DC			X	
	FSSP 100			X	
	DATA SYSTEM			X	
IPC				X	
FOIL				X	
CO_2 RADIOMETER				X	
MICRO. RADIOMETER				X	
SFC. RADIOMETER				X	
FORMVAR				X	
PHOTOGRAPHY	FWD			X	
	LS			X	
	RS			X	
	DWN			X	
AXBT	TUBES			X	
	RECEIVERS			X	
ODW				X	

STORM NAME	DATE(S) FLOWN	MISSION(S) IDENT.	TYPE[4]	REMARKS	FIGURES
DEBBY	13 Sept 1982	820913H	R/R	Atlantic	16,18
	14 Sept 1982	820914I	ODW/PBL		16,19,20
	14 Sept 1982	820914H	ODW		16,21
	15 Sept 1982	820915I	ODW		16,22
	15 Sept 1982	820915H	ODW		16,23

Hurricane DEBBY (13-20 September 1982): Debby formed from a tropical disturbance that moved off the northwest coast of Africa in early September and tracked across the Atlantic as an active tropical wave. The system, unable to develop a circulation before reaching the area of the Lesser Antilles, became a depression just north of the Dominican Republic on 13 September. The depression rapidly intensified and became a tropical storm on the morning of 14 September and a hurricane by nightfall. Debby moved north-northwest through the Atlantic, passing to within 70 nmi (130 km) of Bermuda on 16 September. Once at higher latitudes in the westerlies, Debby moved rapidly eastward toward Europe and was eventually caught up in a major storm system over the British Isles on 20 September. [Clark, 1982a,b; National Climatic Center, 1982b.]

4. R/R: Reconnaissance (NHC) and research (NHRL) mission objectives.

ODW: Omega dropwindsonde/synoptic-flow experiment. Data were provided to NHC and the National Meteorological Center (NMC) in near real-time.

PBL: (Hurricane) planetary boundary-layer experiment. This mission included a feasibility test of the airborne Doppler radar system.

Fig. 18. DEBBY (14 September 1982/0201 GMT) GOES-EAST/FULL DISC IR.

FLIGHT LOG

Date:	September 13, 1982
Flight Identification:	820913H
Aircraft:	WP-3D/N42RF
Departed:	Miami, Florida, at 13/2215 GMT
Arrived:	Miami, Florida, at 14/0600 GMT
Purpose:	Reconnaissance (NHC)/research (NHRL) - T. S. DEBBY.
Pattern:	VI A (modified) at 1.5 K ft altitude.* Single-aircraft mission.

FILM LOG

Camera	Roll	From [Day/Time (GMT)]	To [Day/Time (GMT)]

NO FILM TAKEN

*Ref. Hurricane Field Program Plan, 1982 - p. 35.

TAPE LOG: 820913H

Tape Type	Number	From [Day/Time (GMT)]	To [Day/Time (GMT)]
Radar	1/7	13/0034	13/0100
Radar	2/7	13/0034	13/0153
Radar	3/7	13/0134	13/0231
Radar	4/7	13/0156	13/0317
Radar	5/7	13/0239	13/0342
Radar	6/7	13/0318	13/0416
Radar	7/7	13/0342	13/0416
Knollenberg	1/2	13/0144	13/0313
Knollenberg	2/2	13/0313	13/0322

EQUIPMENT STATUS: 820913H

SYSTEM	STATUS /	UP	DOWN	NOT USED	REMARKS
NAV	INE 1	X			
	INE 2	X			
	ONE	X			
	DOPL	X			
RADAR	NOSE	X			
	LF	X			
	TAIL	X			
	DOPPLER	X			
	DATA SYSTEM	X			
RAMS	DATA SYSTEM	X			
	TOTAL TEMP. 1	X			
	TOTAL TEMP. 2	X			
	DEW POINT	X			
	ATTACK ANGLE	X			
	SLIP ANGLE	X			
	ABS. PRESS.	X			
	DIFF. PRESS.	X			
	RADAR ALT.	X			
	J & W	X			
PMS	OAP 2DP			X	
	OAP 2DC			X	
	FSSP 100	X			
	DATA SYSTEM	X			
IPC				X	
FOIL				X	
CO_2 RADIOMETER				X	
MICRO. RADIOMETER				X	
SFC. RADIOMETER				X	
FORMVAR				X	
PHOTOGRAPHY	FWD			X	
	LS			X	
	RS			X	
	DWN			X	
AXBT	TUBES			X	
	RECEIVERS			X	
ODW				X	

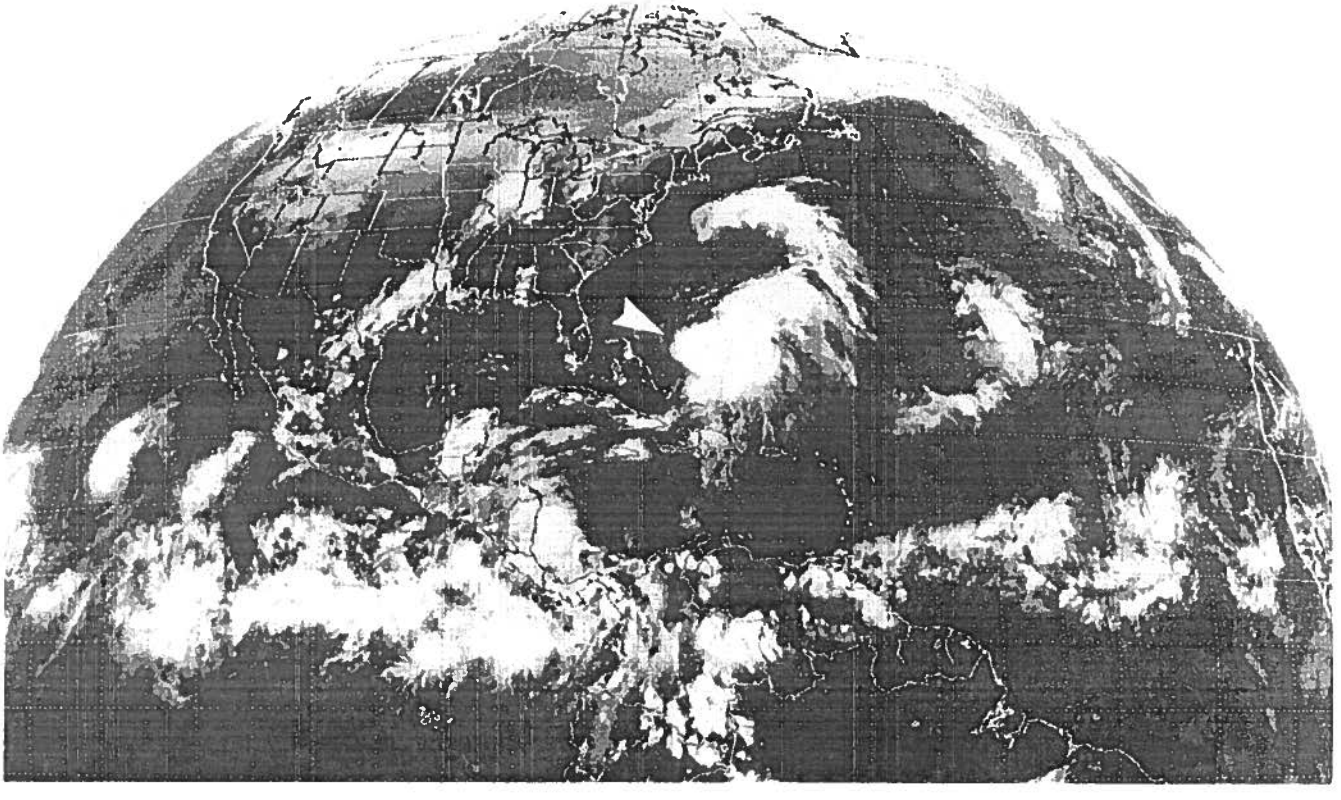
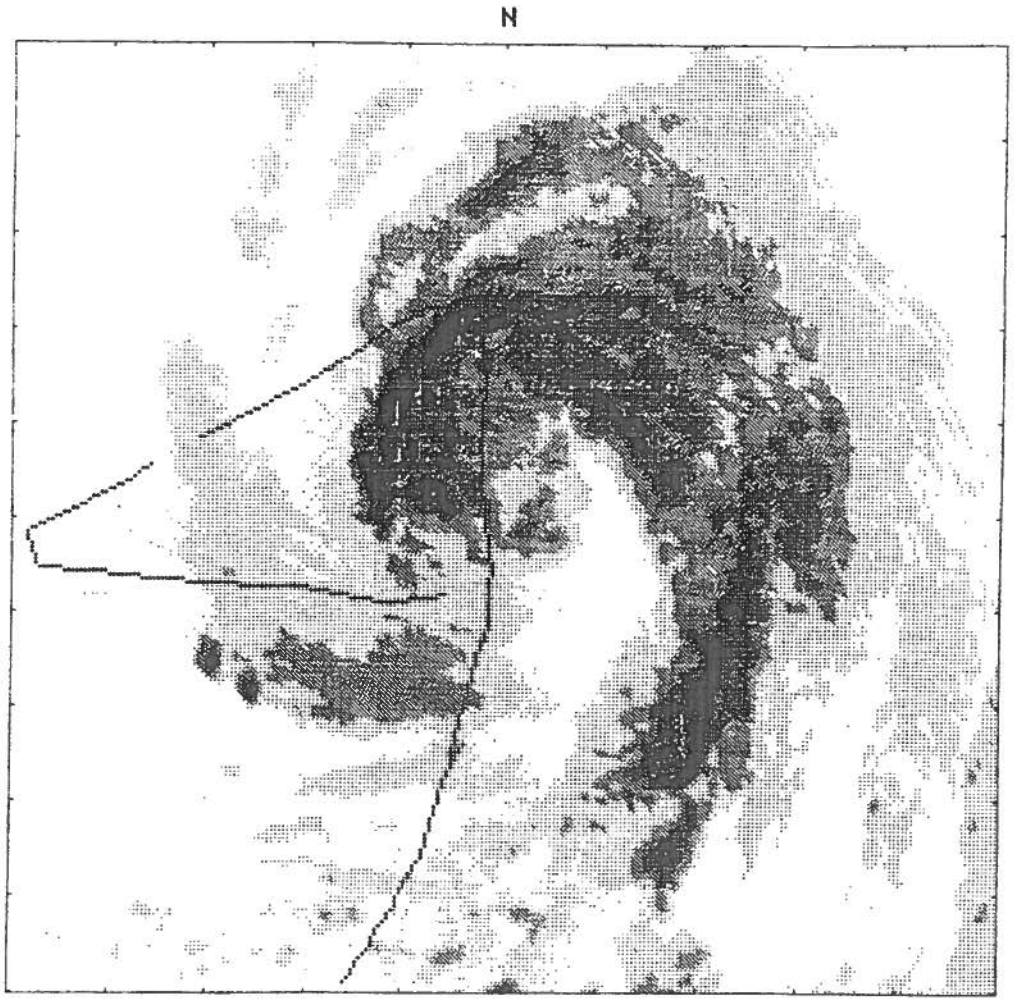


Fig. 19. DEBBY (14 September 1982/2201 GMT) GOES-EAST/FULL DISC IR.



CURSOR POSITION (ORIGIN) RELATIVE TO STORM CENTER

PEAK REFLECTIVITY (DBZ) AT LOCATION (166.5, 70.5) KM FROM CURSOR POINT= 46.75

THRESHOLD (DBZ)	< 25.0	25.0	30.0	35.0	40.0	NO ECHO	TOTAL
AREA (KM**2)	29300.	15845.	7327.	3715.	1025.	388.	57600.

Fig. 20. Hurricane DEBBY, flight 820914I, 193005-203946 GMT: Lower fuselage radar time composite and aircraft track.

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FLIGHT LOG

Date:	September 14, 1982
Flight Identification:	820914I
Aircraft:	WP-3D/N43RF
Departed:	Miami, Florida, at 14/1705 GMT
Arrived:	Miami, Florida, at 15/0305 GMT
Purpose:	Reconnaissance (NHC)/research (NHRL) - T. S. DEBBY.
Pattern:	See Fig. 2/south (modified); Fig. 3 (modified)/variable altitude. Two-aircraft mission/five fixes. ODW/PBL-airborne Doppler feasibility test.

FILM LOG

Camera	Roll	From [Day/Time (GMT)]	To [Day/Time (GMT)]
Left-side	1	14/1705	15/0305
Right-side	1	14/1705	15/0305
Forward	1	14/1705	15/0305
Down	1	14/1705	15/0305

ODW LOG: 820914I

ODW Number	Drop [Day/Time (GMT)]	Comments
1	14/1810	
2	14/1836	
3	14/1900	

TAPE LOG: 820914I

Tape Type	Number	From [Day/Time (GMT)]	To [Day/Time (GMT)]
RFC Standard	1/01	14/1706	15/0255
Slow	1/01	14/1706	15/0255
Radar	1/12	14/1859	14/2040
Radar	2/12	14/1943	14/2022
Radar	3/12	14/2028	14/2107
Radar	4/12	14/2054	14/2219
Radar	5/12	14/2108	14/2146
Radar	6/12	14/2147	14/2226
Radar	7/12	14/2220	14/2326
Radar	8/12	14/2228	14/2304
Radar	9/12	14/2328	15/0056
Radar	10/12	14/2306	14/2329
Radar	11/12	14/2330	15/0009
Radar	12/12	15/0011	15/0050
Knollenberg	1/09	14/1932	14/1948
Knollenberg	2/09	14/1948	14/2004
Knollenberg	3/09	14/2004	14/2042
Knollenberg	4/09	14/2042	14/2100
Knollenberg	5/09	14/2100	14/2111
Knollenberg	6/09	14/2111	14/2121
Knollenberg	7/09	14/2121	14/2147
Knollenberg	8/09	14/2147	14/2200
Knollenberg	9/09	14/2220	14/2215
Doppler	1/13	14/1943	14/2002
Doppler	2/13	14/2005	14/2022
Doppler	3/13	14/2025	14/2044
Doppler	4/13	14/2051	14/2106
Doppler	5/13	14/2109	14/2128
Doppler	6/13	14/2134	14/2152
Doppler	7/13	14/2155	14/2215
Doppler	8/13	14/2218	14/2236
Doppler	9/13	14/2259	14/2318
Doppler	10/13	14/2332	14/2345
Doppler	11/13	14/2349	15/0003
Doppler	12/13	15/0006	15/0025
Doppler	13/13	15/0028	15/0037

EQUIPMENT STATUS: 820914I

SYSTEM	STATUS /	UP	DOWN	NOT USED	REMARKS
NAV	INE 1	X			
	INE 2	X			
	ONE	X			
	DOPL	X			
RADAR	NOSE	X			
	LF	X			
	TAIL	X			Until 0046 GMT
	DOPPLER	X			
	DATA SYSTEM	X			
R MS	DATA SYSTEM	X			
	TOTAL TEMP. 1	X			
	TOTAL TEMP. 2	X			
	DEW POINT	X			
	ATTACK ANGLE	X			
	SLIP ANGLE	X			
	ABS. PRESS.	X			
	DIFF. PRESS.	X			
	RADAR ALT.	X			
	J & W		X		J & W inop.
PMS	OAP 2DP	X			
	OAP 2DC	X			
	FSSP 100	X			
	DATA SYSTEM	X			
IPC				X	
FOIL				X	
CO_2 RADIOMETER				X	
MICRO. RADIOMETER				X	
SFC. RADIOMETER				X	
FORMVAR				X	
PHOTOGRAPHY	FWD	X			
	LS	X			
	RS	X			
	DWN	X			
AXBT	TUBES			X	
	RECEIVERS			X	
ODW		X			3 drops

Fig. 21. DEBBY (14 September 1982/2231 GMT) GOES-EAST/FULL DISC IR.

FLIGHT LOG

Date:	September 14, 1982
Flight Identification:	820914H
Aircraft:	WP-3D/N42RF
Departed:	Miami, Florida, at 14/1755 GMT
Arrived:	Miami, Florida, at 15/0321 GMT
Purpose:	T. S. DEBBY ODW mission.
Pattern:	See Fig. 2/north (modified); 17-28 K ft altitude. Two aircraft: one north of storm, other in storm. North aircraft step-climbed with fuel burn-off.

FILM LOG

Camera	Roll	From [Day/Time (GMT)]	To [Day/Time (GMT)]
Right-side	1	14/1755	15/0321
Forward	1	14/1755	15/0321
Left-side	1	14/1755	15/0321

ODW LOG: 820914H

ODW/Number	Drop [Day/Time (GMT)]	Comments
1	14/1901	
2	14/1924	
3	14/1937	
4	14/2001	
5	14/2023	
6	14/2044	
7	14/2109	
8	14/2132	
9	14/2145	
10	14/2200	
11	14/2220	
12	14/2237	
13	14/2258	
14	14/2314	
15	14/2330	
16	14/2346	
17	14/2352	
18	15/0003	
19	15/0019	
20	15/0028	
21	15/0046	
22	15/0053	
23	15/0111	
24	15/0130	
25	15/0156	
26	15/0219	

TAPE LOG: 820914H

Tape Type	Number	From [Day/Time (GMT)]	To [Day/Time (GMT)]
Radar	1/3	14/1903	14/2144
Radar	2/3	14/2144	15/0044
Radar	3/3	15/0044	15/0247
RFC Standard	1/1	14/1800	15/0321
Slow	1/1	14/1800	15/0247

EQUIPMENT STATUS: 820914H

SYSTEM	STATUS /	UP	DOWN	NOT USED	REMARKS
NAV	INE 1	X			
	INE 2	X			
	ONE	X			
	DOPL	X			
RADAR	NOSE	X			
	LF	X			
	TAIL	X			
	DOPPLER			X	
	DATA SYSTEM	X			
RAMS	DATA SYSTEM	X			
	TOTAL TEMP. 1	X			
	TOTAL TEMP. 2	X			
	DEW POINT	X			
	ATTACK ANGLE	X			
	SLIP ANGLE	X			
	ABS. PRESS.	X			
	DIFF. PRESS.	X			
	RADAR ALT.	X			
	J & W	X			
PMS	OAP 2DP	X			
	OAP 2DC			X	
	FSSP 100			X	
	DATA SYSTEM			X	
IPC				X	
FOIL				X	
CO_2 RADIOMETER				X	
MICRO. RADIOMETER				X	
SFC. RADIOMETER				X	
FORMVAR				X	
PHOTOGRAPHY	FWD	X			
	LS	X			
	RS	X			
	DWN			X	
AXBT	TUBES			X	
	RECEIVERS				

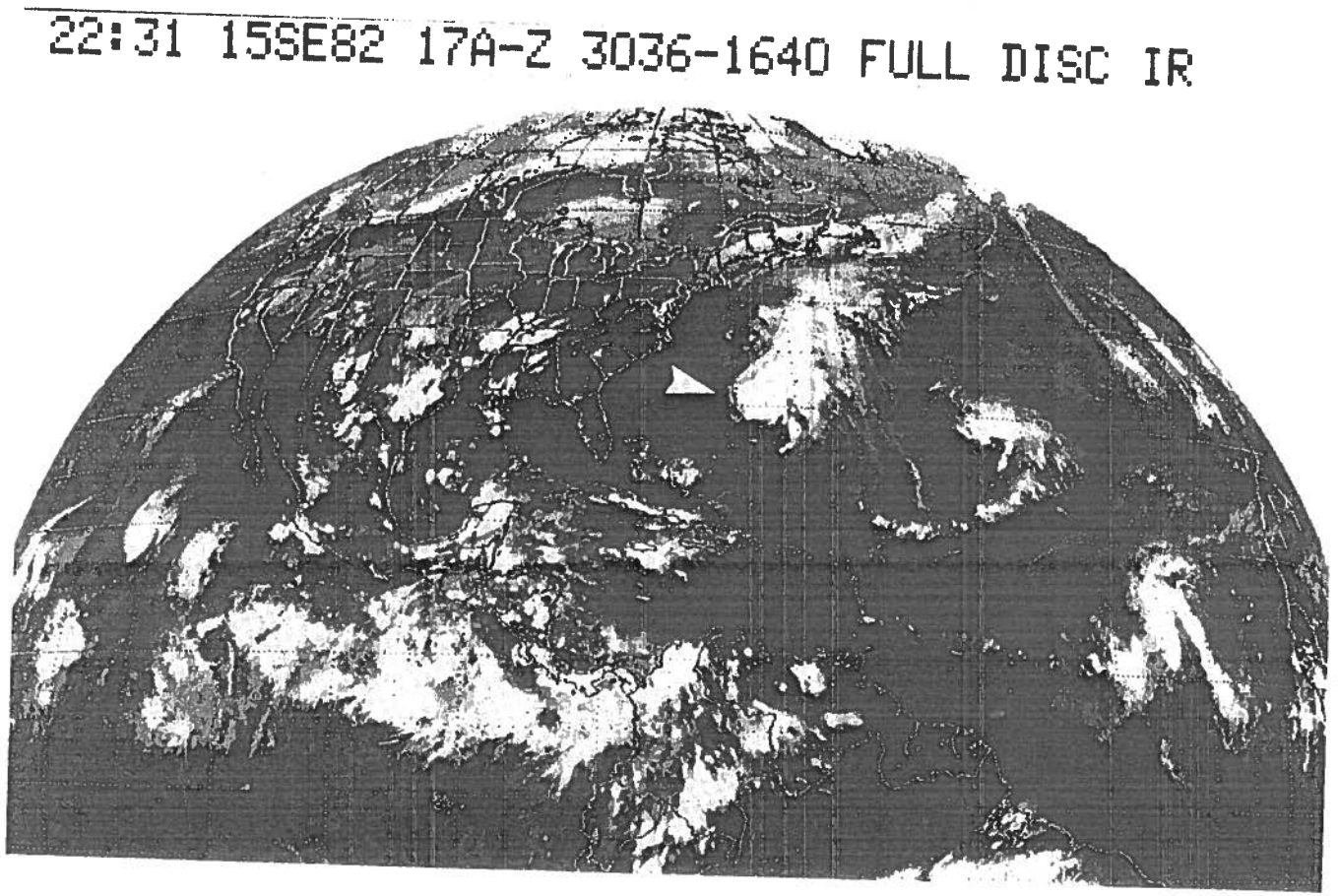

Fig. 22. DEBBY (15 September 1982/2231 GMT) GOES-EAST/FULL DISC IR.

FLIGHT LOG

Date:	September 15, 1982
Flight Identification:	820915I
Aircraft:	WP-3D/N43RF
Departed:	Miami, Florida, at 15/1815 GMT
Arrived:	Miami, Florida, at 16/0320 GMT
Purpose:	NHRL ODW mission - Hurricane DEBBY.
Pattern:	See Fig. 2/south (modified); $\geq$ 19 K ft altitude. Two aircraft: one north of storm, one south. Both aircraft step-climbed with fuel burn-off.

FILM LOG

Camera	Roll	From [Day/Time (GMT)]	To [Day/Time (GMT)]
Right-side	1	15/1815	16/0320
Forward	1	15/1815	16/0320
Down	1	15/1815	16/0320
Left-side	1	15/1815	16/0320

ODW LOG: 820915I

ODW/Number	Drop [Day/Time (GMT)]	Comments
1	15/1923	
2	15/1943	
3	15/2004	
4	15/2021	
5	15/2040	
6	15/2102	
7	15/2124	
8	15/2141	
9	15/2200	
10	15/2214	
11	15/2228	
12	15/2247	
13	15/2305	
14	15/2321	
15	15/2342	
16	15/2357	
17	16/0041	
18	16/0044	
19	16/0049	
20	16/0123	
21	16/0142	
22	16/0158	
23	16/0204	
24	16/0213	

TAPE LOG: 820915I

Tape Type	Number	From [Day/Time (GMT)]	To [Day/Time (GMT)]
RFC Standard	1/1	15/1805	16/0319
Slow	1/1	15/1805	16/0319
Radar	1/2	15/1856	15/2217
Radar	2/2	15/2217	16/0245
Doppler	1/1	15/1903	15/2217

EQUIPMENT STATUS: 820915I

SYSTEM	STATUS /	UP	DOWN	NOT USED	REMARKS
NAV	INE 1	X			
	INE 2	X			
	ONE	X			
	DOPL	X			
RADAR	NOSE	X			
	LF	X			
	TAIL	X			
	DOPPLER	X			
	DATA SYSTEM	X			
RAMS	DATA SYSTEM	X			
	TOTAL TEMP. 1	X			
	TOTAL TEMP. 2	X			
	DEW POINT	X			
	ATTACK ANGLE	X			
	SLIP ANGLE	X			
	ABS. PRESS.	X			
	DIFF. PRESS.	X			
	RADAR ALT.	X			
	J & W	X			
PMS	OAP 2DP	X			
	OAP 2DC	X			
	FSSP 100	X			
	DATA SYSTEM	X			
IPC		X			
FOIL		X			
CO_2 RADIOMETER				X	
MICRO. RADIOMETER				X	
SFC. RADIOMETER				X	
FORMVAR				X	
PHOTOGRAPHY	FWD	X			
	LS	X			
	RS	X			
	DWN	X			
AXBT	TUBES			X	
	RECEIVERS			X	
ODU		X			24 drops

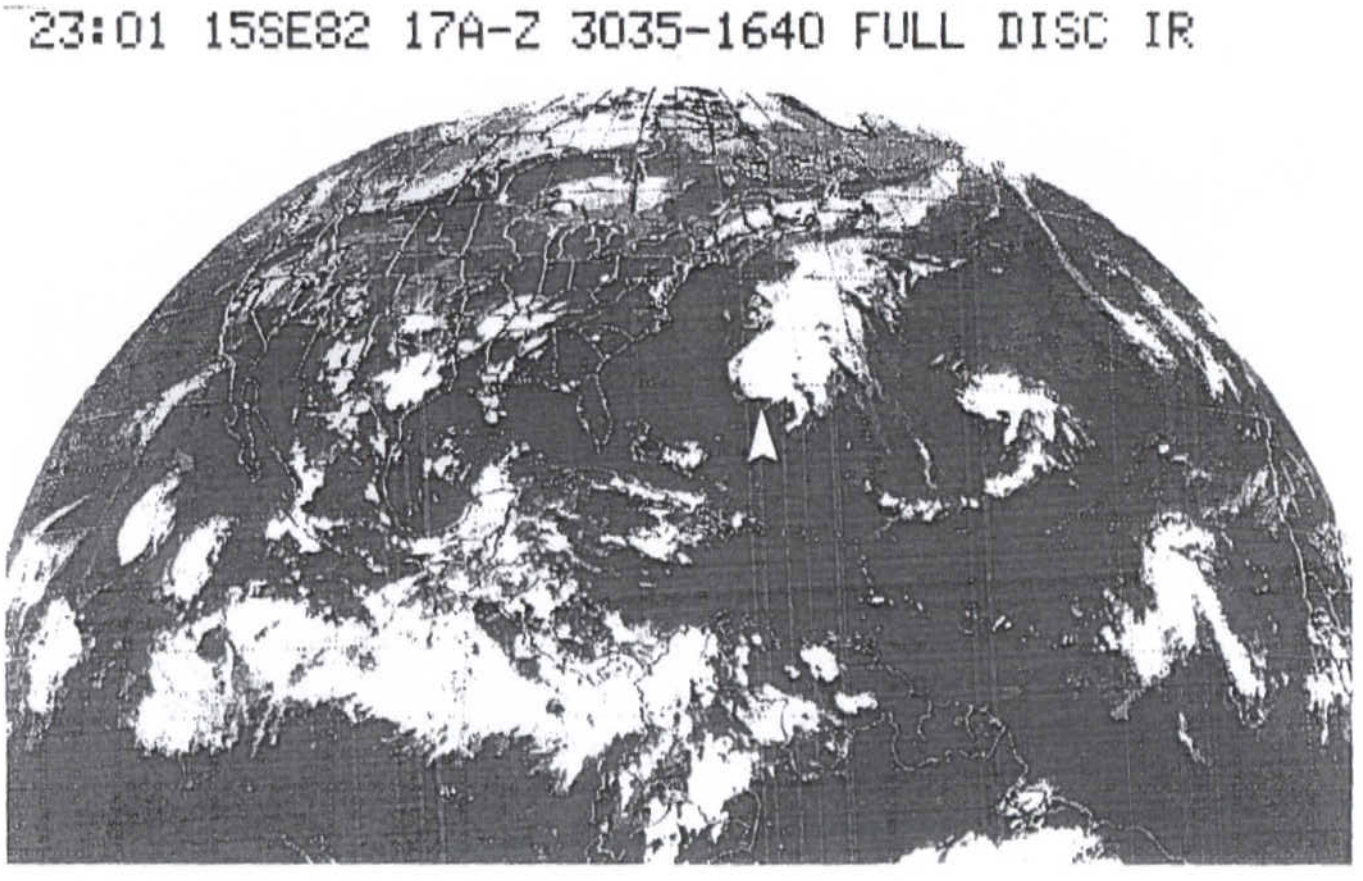

Fig. 23. DEBBY (15 September 1982/2301 GMT) GOES-EAST/FULL DISC IR.

FLIGHT LOG

Date:	September 15, 1982
Flight Identification:	820915H
Aircraft:	WP-3D/N42RF
Departed:	Miami, Florida, at 15/1800 GMT
Arrived:	Langley AFB, Virginia, at 16/0345 GMT
Purpose:	NHRL ODW mission - Hurricane DEBBY.
Pattern:	See Fig. 2/north (modified); altitudes 17, 21, 23, 24, and 26 K ft. Two aircraft: one north of storm, one south. Both aircraft step-climbed with fuel burn-off.

FILM LOG

Camera	Roll	From [Day/Time (GMT)]	To [Day/Time (GMT)]
Left-side	1	15/1800	16/0345
Right-side	1	15/1800	16/0345
Forward	1	15/1800	16/0345

ODW LOG: 820915H

ODW/Number	Drop [Day/Time (GMT)]	Comments
1	15/1903	
2	15/1922	
3	15/1941	
4	15/2001	
5	15/2022	
6	15/2042	
7	15/2045	
8	15/2057	
9	15/2129	
10	15/2157	
11	15/2217	
12	15/2235	
13	15/2255	
14	15/2257	
15	15/2316	
16	15/2333	
17	15/2358	
18	16/0015	
19	16/0037	
20	16/0055	
21	16/0114	
22	16/0134	
23	16/0136	
24	16/0151	
25	16/0213	
26	16/0220	
27	16/0234	

TAPE LOG: 820915H

Tape Type	Number	From [Day/Time (GMT)]	To [Day/Time (GMT)]
Radar	1/3	15/1822	15/2105
Radar	2/3	15/2105	15/2350
Radar	3/3	15/2351	16/0345
RFC Standard	1/1	15/1815	16/0345
Slow	1/1	15/1815	16/0345

EQUIPMENT STATUS: 820915H

SYSTEM	STATUS /	UP	DOWN	NOT USED	REMARKS
NAV	INE 1	X			
	INE 2	X			
	ONE	X			
	DOPL	X			
RADAR	NOSE	X			
	LF	X			
	TAIL	X			
	DOPPLER			X	
	DATA SYSTEM	X			
RAMS	DATA SYSTEM	X			
	TOTAL TEMP. 1	X			
	TOTAL TEMP. 2	X			
	DEW POINT	X			
	ATTACK ANGLE	X			
	SLIP ANGLE	X			
	ABS. PRESS.	X			
	DIFF. PRESS.	X			
	RADAR ALT.	X			
	J & W	X			
PMS	OAP 2DP			X	
	OAP 2DC			X	
	FSSP 100			X	
	DATA SYSTEM			X	
IPC				X	
FOIL				X	
CO_2 RADIOMETER				X	
MICRO. RADIOMETER				X	
SFC. RADIOMETER				X	
FORMVAR				X	
PHOTOGRAPHY	FWD	X			
	LS	X			
	RS	X			
	DWN			X	
AXBT	TUBES			X	
	RECEIVERS			X	
ODW		X			27 drops

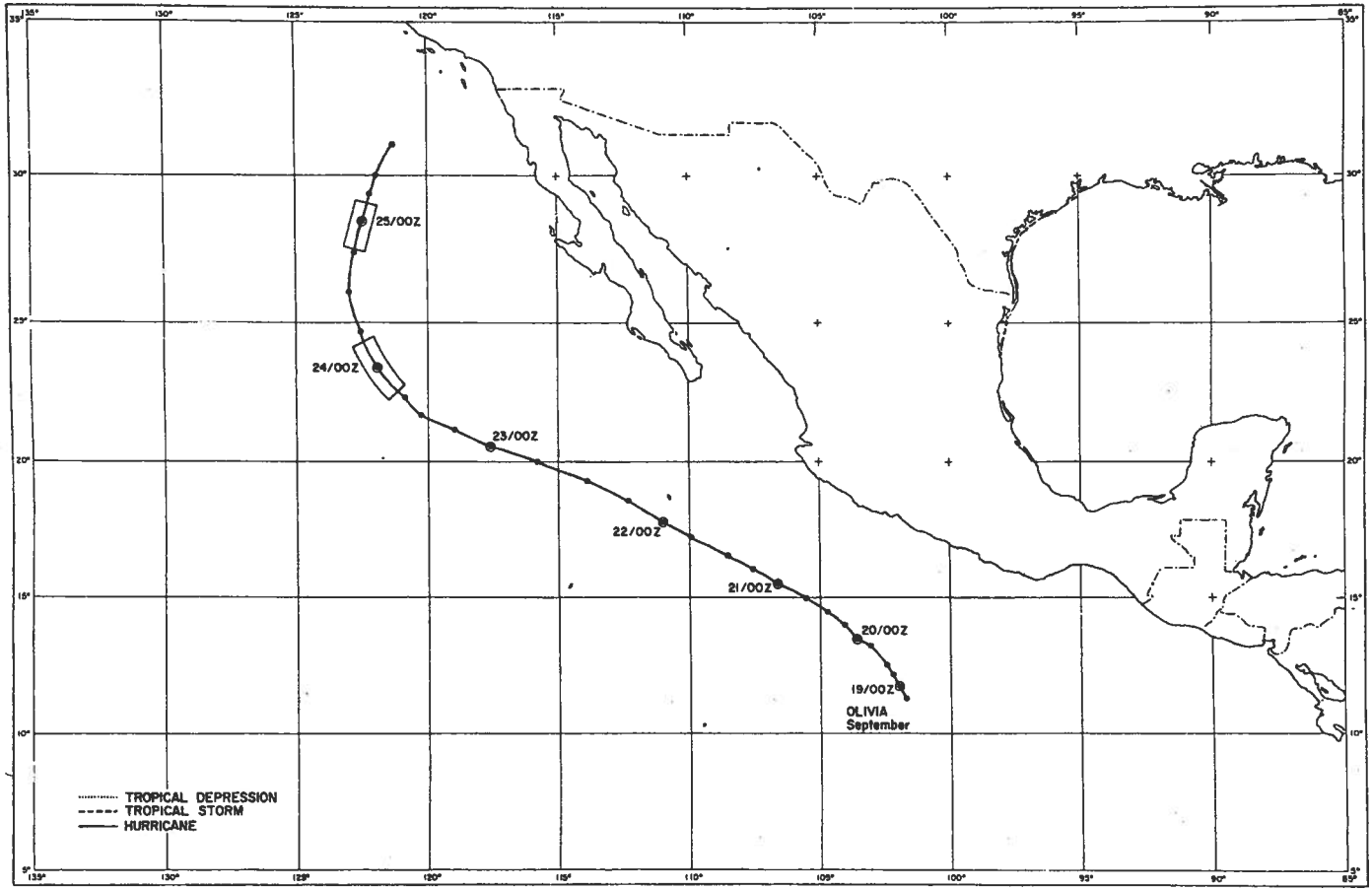

Fig. 24. Best-track plot for Eastern Pacific storm investigated by NHRL during the 1982 hurricane season.

STORM NAME	DATE(S) FLOWN	MISSION(S) IDENT.	TYPE[5]	REMARKS	FIGURES
OLIVIA	23 Sept 1982	820923I	ODW	E. Pacific	24,25
	23 Sept 1982	820923H	ODW		24,26
	24 Sept 1982	820924H	ODW		24,27
	24 Sept 1982	820924I	ODW		24,28

Hurricane OLIVIA (18-25 September 1982): A tropical cyclone was reported about 350 nmi (648 km) south-southwest of Acapulco, Mexico, at 1800 GMT/18 September. Drifting slowly to the north-northwest, the cyclone intensified rapidly and was upgraded to tropical storm status at 0600 GMT/19 September. Olivia continued to intensify and reached hurricane strength at 0600 GMT/20 September. Hurricane-force winds continued through 0600 GMT/22 September when the hurricane began to weaken. Olivia was downgraded to a tropical storm at 1800 GMT/23 September. Though weakened, the storm produced moderate to heavy rain over much of California, with the result that substantial losses were suffered by the state's agricultural industry. By 1800 GMT/25 September the last cyclone advisory was issued by EPHC. The system continued to dissipate rapidly about 240 nmi (445 km) west-southwest of San Diego, California. [Gunther et al., 1983.]

5. ODW: Omega dropwindsonde/synoptic-flow experiment. Data were provided to EPHC, NHC, and NMC in near real-time.

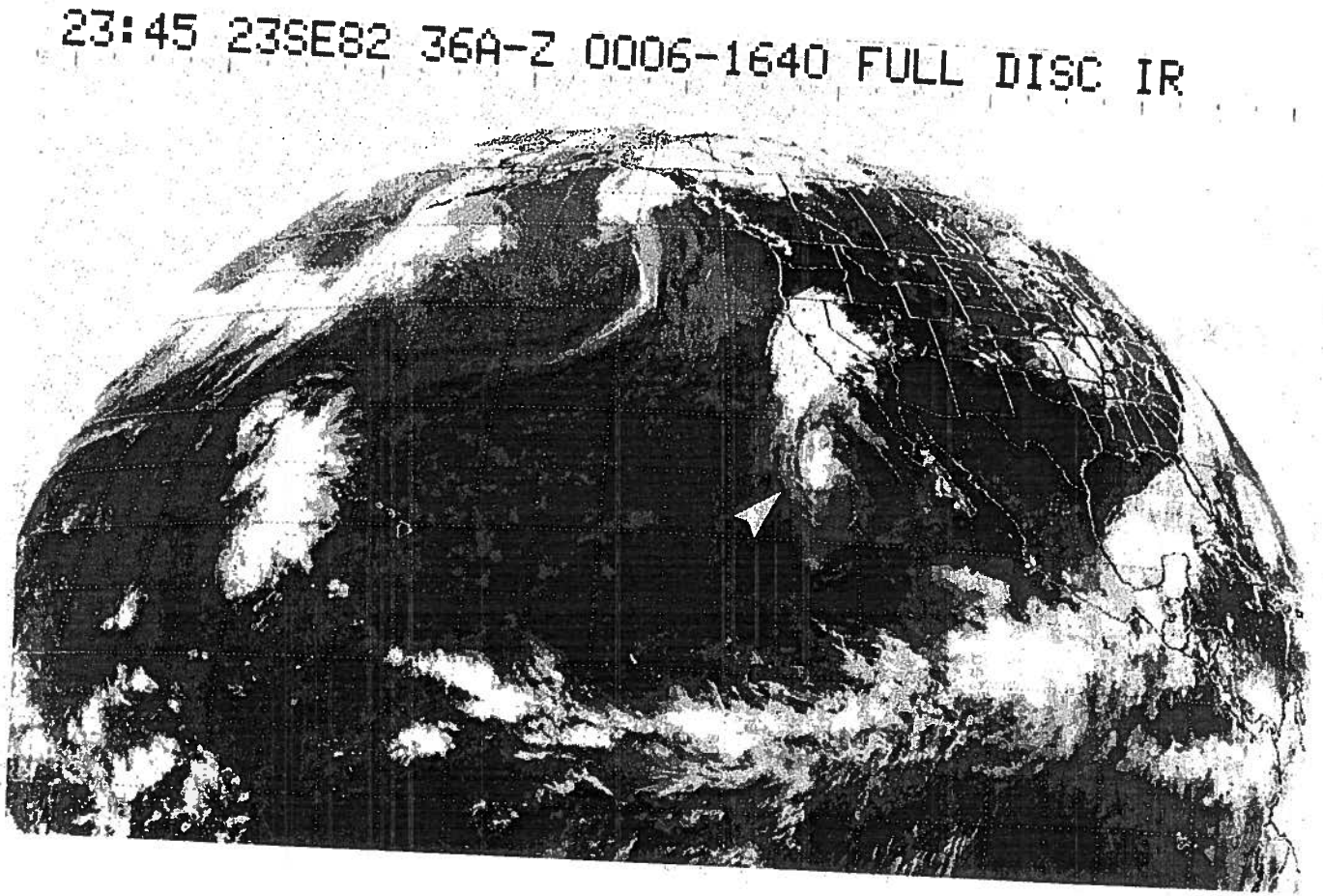

Fig. 25. OLIVIA (23 September 1982/2345 GMT) GOES-WEST/FULL DISC IR.

FLIGHT LOG

Date:	September 23, 1982
Flight Identification:	820923I
Aircraft:	WP-3D/N43RF
Departed:	San Diego, California, at 23/1840 GMT
Arrived:	San Diego, California, at 24/0420 GMT
Purpose:	NHRL ODW mission - Hurricane OLIVIA.
Pattern:	See Fig. 2/south (modified - E. Pacific); 18-22 K ft altitude. Two aircraft: one north, one south of storm. Step-climbed with fuel burn-off.

FILM LOG

Camera	Roll	From [Day/Time (GMT)]	To [Day/Time (GMT)]
Left-side	1	23/1840	24/0420
Right-side	1	23/1840	24/0420
Forward	1	23/1840	24/0420
Down	1	23/1840	24/0420

ODW LOG: 820923I

ODW/Number	Drop [Day/Time (GMT)]	Comments
1	23/1934	
2	23/2002	
3	23/2004	
4	23/2020	
5	23/2039	
6	23/2109	
7	23/2111	
8	23/2116	
9	23/2140	
10	23/2202	
11	23/2225	
12	23/2248	
13	23/2310	
14	23/2334	
15	23/2336	
16	23/2351	
17	24/0015	
18	24/0039	
19	24/0059	
20	24/0120	
21	24/0138	
22	24/0156	
23	24/0216	
24	24/0238	
25	24/0252	
26	24/0307	
27	24/0327	

TAPE LOG: 820923I

Tape Type	Number	From [Day/Time (GMT)]	To [Day/Time (GMT)]
RFC Standard	1/1	23/1839	24/0417
Slow	1/1	23/1839	24/0417
Radar	1/2	23/2000	24/0200
Radar	2/2	24/0200	24/0400

EQUIPMENT STATUS: 820923I

SYSTEM	STATUS /	UP	DOWN	NOT USED	REMARKS
NAV	INE 1	X			
	INE 2	X			
	ONE	X			
	DOPL			X	
RADAR	NOSE	X			
	LF	X			
	TAIL	X			
	DOPPLER	X			
	DATA SYSTEM	X			
RAMS	DATA SYSTEM	X			
	TOTAL TEMP. 1	X			
	TOTAL TEMP. 2	X			
	DEW POINT	X			
	ATTACK ANGLE	X			
	SLIP ANGLE	X			
	ABS. PRESS.	X			
	DIFF. PRESS.	X			
	RADAR ALT.	X			
	J & W	X			
PMS	OAP 2DP			X	
	OAP 2DC			X	
	FSSP 100			X	
	DATA SYSTEM			X	
IPC				X	
FOIL				X	
CO_2 RADIOMETER				X	
MICRO. RADIOMETER				X	
SFC. RADIOMETER				X	
FORMVAR				X	
PHOTOGRAPHY	FWD	X			
	LS	X			
	RS	X			
	DWN	X			
AXBT	TUBES			X	
	RECEIVERS			X	
ODW		X			27 drops

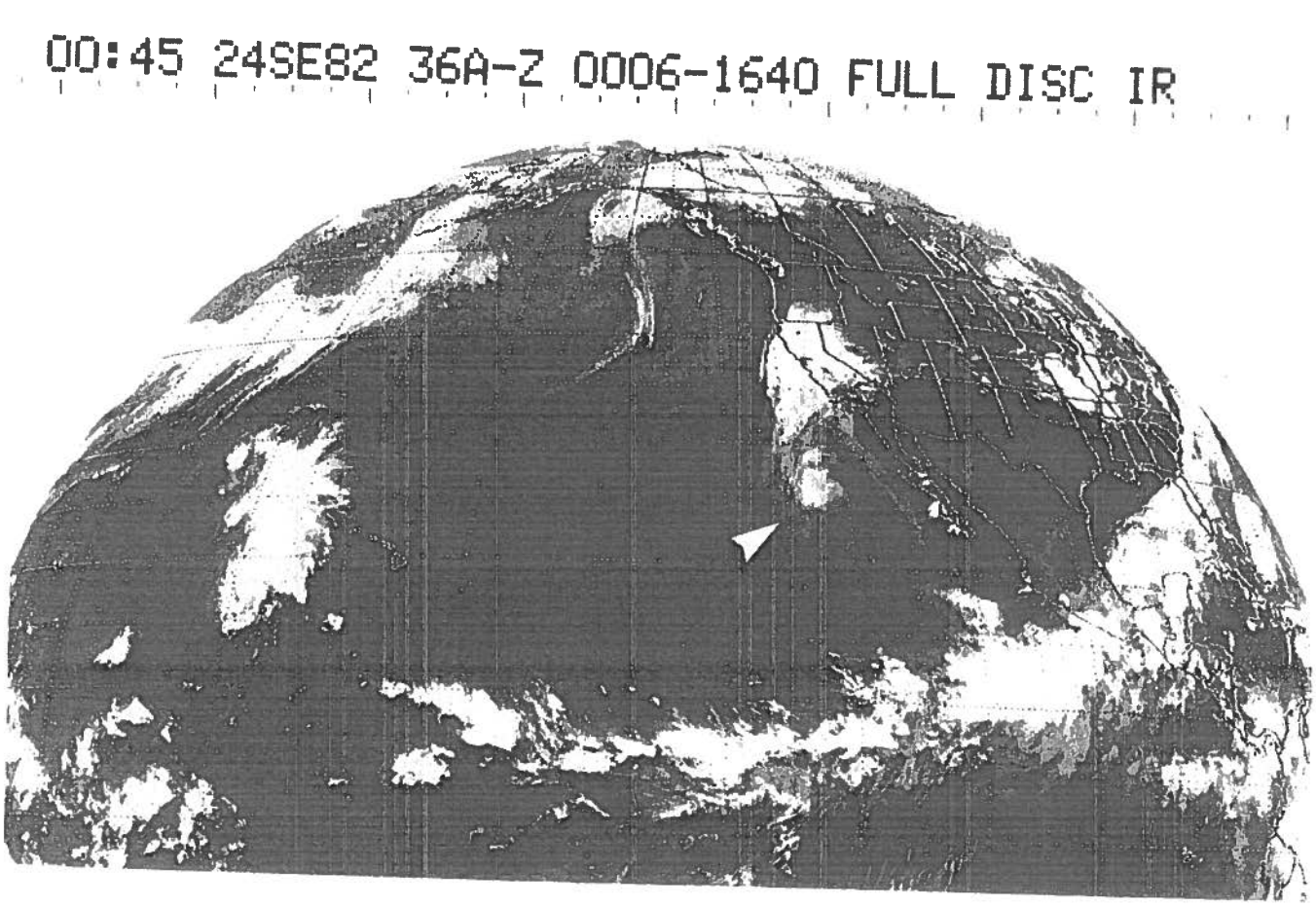

Fig. 26. OLIVIA (24 September 1982/0045 GMT) GOES-WEST/FULL DISC IR.

FLIGHT LOG

Date:	September 23, 1982
Flight Identification:	820923H
Aircraft:	WP-3D/N42RF
Departed:	San Diego, California, at 23/1915 GMT
Arrived:	San Diego, California, at 24/0425 GMT
Purpose:	NHRL ODW mission - Hurricane OLIVIA.
Pattern:	See Fig. 2/north (modified - E. Pacific); altitudes 19, 20, 21, 24, and 26 K ft. Two aircraft: one north of storm, one south. Both step-climbed with fuel burn-off.

FILM LOG

Camera	Roll	From [Day/Time (GMT)]	To [Day/Time (GMT)]
Left-side	1	23/1915	24/0425
Right-side	1	23/1915	24/0425
Forward	1	23/1915	24/0425

ODW LOG: 820923H

ODW/Number	Drop [Day/Time (GMT)]	Comments
1	23/2059	
2	23/2124	
3	23/2149	
4	23/2150	
5	23/2212	
6	23/2234	
7	23/2258	
8	23/2323	
9	23/2340	
10	23/2359	
11	24/0017	
12	24/0031	
13	24/0046	
14	24/0101	
15	24/0109	
16	24/0135	
17	24/0153	
18	24/0215	
19	24/0230	
20	24/0233	
21	24/0252	
22	24/0313	

TAPE LOG: 820923H

Tape Type	Number	From [Day/Time (GMT)]	To [Day/Time (GMT)]
RFC Standard	1/1	23/1925	24/0424
Radar	1/3	23/2033	24/0126
Radar	2/3	24/0127	24/0340
Radar	3/3	24/0340	24/0420
Knollenberg	1/2	23/2059	24/0252
Knollenberg	2/2	24/0252	24/0330
Slow	1/1	23/1925	24/0424

EQUIPMENT STATUS: 820923H

SYSTEM	STATUS /	UP	DOWN	NOT USED	REMARKS
NAV	INE 1	X			
	INE 2	X			
	ONE	X			
	DOPL	X			
RADAR	NOSE	X			
	LF	X			
	TAIL	X			
	DOPPLER	X			
	DATA SYSTEM	X			
RAMS	DATA SYSTEM	X			
	TOTAL TEMP. 1	X			
	TOTAL TEMP. 2	X			
	DEW POINT	X			
	ATTACK ANGLE	X			
	SLIP ANGLE	X			
	ABS. PRESS.	X			
	DIFF. PRESS.	X			
	RADAR ALT.	X			Down for 1 h
	J & W	X			
PMS	OAP 2DP	X			
	OAP 2DC	X			
	FSSP 100	X			
	DATA SYSTEM	X			
IPC		X			
FOIL		X			
CO_2 RADIOMETER		X			
MICRO. RADIOMETER		X			
SFC. RADIOMETER		X			
FORMVAR		X			
PHOTOGRAPHY	FWD	X			
	LS	X			
	RS	X			
	DWN			X	
AXBT	TUBES	X			
	RECEIVERS	X			
ODW		X			22 drops

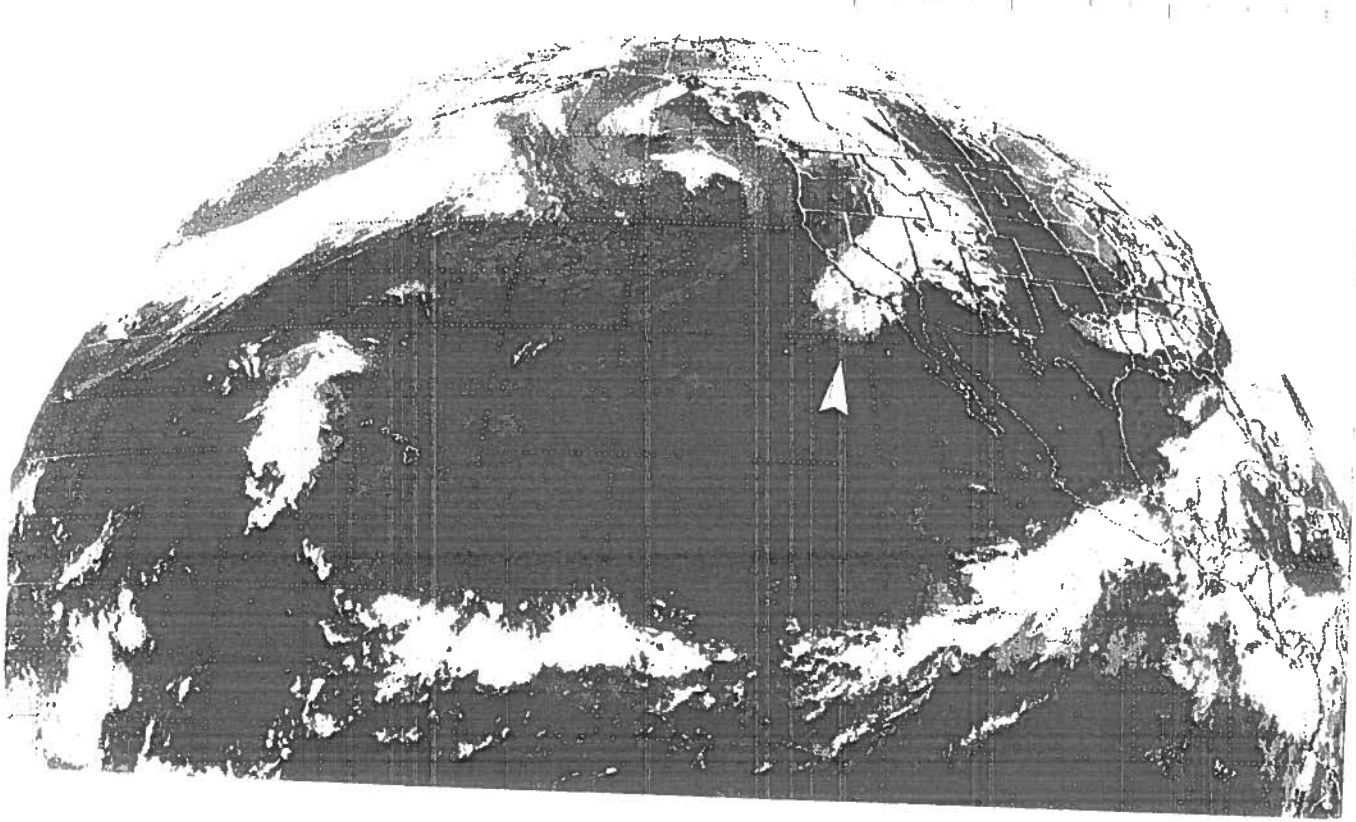

Fig. 27. OLIVIA (24 September 1982/2245 GMT) GOES-WEST/FULL DISC IR.

FLIGHT LOG

Date:	September 24, 1982
Flight Identification:	820924H
Aircraft:	WP-3D/N42RF
Departed:	San Diego, California, at 24/1830 GMT
Arrived:	San Diego, California, at 25/0315 GMT
Purpose:	NHRL ODW mission - T. S. OLIVIA.
Pattern:	See Fig. 2/north (modified - E. Pacific); altitudes 18-22 K ft. Two aircraft: one north of storm, one south. Both step-climbed with fuel burn-off. North flight aborted 25/0140 GMT (preventative engine shutdown).

FILM LOG

Camera	Roll	From [Day/Time (GMT)]	To [Day/Time (GMT)]
Left-side	1	24/1830	25/0315
Right-side	1	24/1830	25/0315
Forward	1	24/1830	25/0315

ODW LOG: 820924H

ODW/Number	Drop [Day/Time (GMT)]	Comments
1	24/1929	
2	24/1947	
3	24/2009	
4	24/2017	
5	24/2031	
6	24/2053	
7	24/2102	
8	24/2126	
9	24/2201	
10	24/2217	
11	24/2235	
12	24/2254	
13	24/2303	
14	24/2320	
15	24/2335	
16	24/2352	
17	25/0015	
18	25/0029	
19	25/0044	
20	25/0100	
21	25/0118	
22	25/0128	
23	25/0137	
24	25/0152	

TAPE LOG: 820924H

Tape Type	Number	From [Day/Time (GMT)]	To [Day/Time (GMT)]
Radar	1/3	24/1900	24/2020
Radar	2/3	24/2020	24/2104
Radar	3/3	24/2104	24/2318
RFC Standard	1/1	24/1840	24/0305
Slow	1/1	24/1840	24/0305
Knollenberg	1/1	24/2130	24/2150

EQUIPMENT STATUS: 820924H

SYSTEM	STATUS /	UP	DOWN	NOT USED	REMARKS
NAV	INE 1	X			
	INE 2	X			
	ONE	X			
	DOPL	X			
RADAR	NOSE	X			
	LF	X			
	TAIL	X			
	DOPPLER			X	
	DATA SYSTEM	X			
RAMS	DATA SYSTEM	X			
	TOTAL TEMP. 1	X			
	TOTAL TEMP. 2	X			
	DEW POINT	X			
	ATTACK ANGLE	X			
	SLIP ANGLE	X			
	ABS. PRESS.	X			
	DIFF. PRESS.	X			
	RADAR ALT.	X			
	J & W	X			
PMS	OAP 2DP	X			
	OAP 2DC			X	
	FSSP 100			X	
	DATA SYSTEM			X	
IPC				X	
FOIL				X	
CO_2 RADIOMETER				X	
MICRO. RADIOMETER				X	
SFC. RADIOMETER				X	
FORMVAR				X	
PHOTOGRAPHY	FWD	X			
	LS	X			
	RS	X			
	DWN			X	
AXBT	TUBES			X	
	RECEIVERS			X	
ODW		X			24 drops in flight

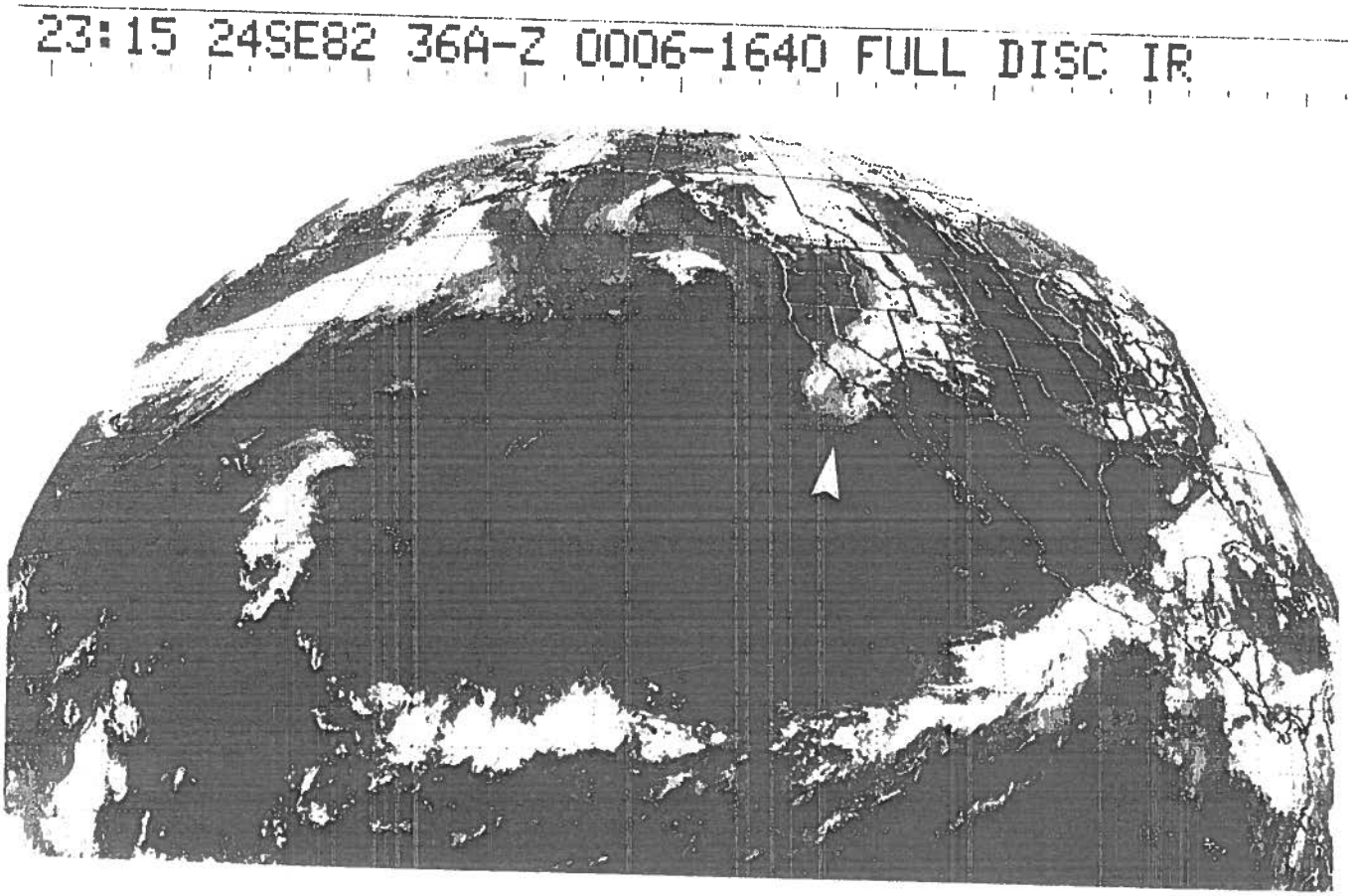

Fig. 28. OLIVIA (24 September 1982/2315 GMT) GOES-WEST/FULL DISC IR.

FLIGHT LOG

Date:	September 24, 1982
Flight Identification:	820924I
Aircraft:	WP-3D/N43RF
Departed:	San Diego, California, at 24/1820 GMT
Arrived:	San Diego, California, at 25/0340 GMT
Purpose:	NHRL ODW mission - Hurricane OLIVIA.
Pattern:	See Fig. 2/south (modified - E. Pacific); altitudes 18-24 K ft. Two aircraft: one north of storm, one south. Both step-climbed with fuel burn-off. North aircraft aborted at 25/0140 GMT due to engine shut-down.

FILM LOG

Camera	Roll	From [Day/Time (GMT)]	To [Day/Time (GMT)]
Left-side	1	24/1820	25/0340
Right-side	1	24/1820	25/0340
Forward	1	24/1820	25/0340
Down	1	24/1820	25/0340

ODW LOG: 820924I

ODW/Number	Drop [Day/Time (GMT)]	Comments
1	24/1906	
2	24/1930	
3	24/1959	
4	24/2000	
5	24/2003	
6	24/2027	
7	24/2029	
8	24/2046	
9	24/2106	
10	24/2125	
11	24/2150	
12	24/2217	
13	24/2244	
14	24/2251	
15	24/2309	
16	24/2324	
17	24/2340	
18	24/2357	
19	25/0018	
20	25/0039	
21	25/0056	
22	25/0059	
23	25/0113	
24	25/0131	
25	25/0150	
26	25/0208	
27	25/0212	
28	25/0226	
29	25/0243	
30	25/0300	

TAPE LOG: 820924I

Tape Type	Number	From [Day/Time (GMT)]	To [Day/Time (GMT)]
Radar	1/2	24/1846	25/0009
Radar	2/2	25/0009	25/0312
RFC Standard	1/1	24/1823	25/0341
Slow	1/1	24/1823	25/0341

EQUIPMENT STATUS: 820924I

SYSTEM	STATUS /	UP	DOWN	NOT USED	REMARKS
NAV	INE 1	X			
	INE 2	X			
	ONE	X			
	DOPL	X			
RADAR	NOSE	X			
	LF	X			
	TAIL	X			
	DOPPLER			X	
	DATA SYSTEM	X			
RAMS	DATA SYSTEM	X			
	TOTAL TEMP. 1	X			
	TOTAL TEMP. 2	X			
	DEW POINT	X			
	ATTACK ANGLE	X			
	SLIP ANGLE	X			
	ABS. PRESS.	X			
	DIFF. PRESS.	X			
	RADAR ALT.	X			
	J & W	X			
PMS	OAP 2DP			X	
	OAP 2DC			X	
	FSSP 100			X	
	DATA SYSTEM			X	
IPC				X	
FOIL				X	
CO_2 RADIOMETER				X	
MICRO. RADIOMETER				X	
SFC. RADIOMETER				X	
FORMVAR				X	
PHOTOGRAPHY	FWD	X			
	LS	X			
	RS	X			
	DWN	X			
AXBT	TUBES			X	
	RECEIVERS			X	
ODW		X			30 drops

Table 8. Data documented in section 8.2: 1983

Storm	Mission ident.	Best-track figure	Satellite figure	Flight/tape logs	Equipment status
ALICIA	830816H	29	30	Yes/Yes	Yes
	830817I1	29	31	Yes/Yes	Yes
	830817H	29	32	Yes/Yes	Yes
	830817I2	29	34	Yes/Yes	Yes
	830818H	29	35	Yes/Yes	Yes
BARRY	830823I	29	36	Yes/Yes	Yes
	830825H	29	37	Yes/Yes	Yes
DEAN	830928I	29	38	Yes/Yes	Yes
	830929H1	29	39	Yes/Yes	Yes
	830929I	29	40	Yes/Yes	Yes
RAYMOND	831010I	41	42	Yes/Yes	Yes
	831010H	41	43	Yes/Yes	Yes
TICO	831013I	41	44	Yes/Yes	Yes
	831013H	41	45	Yes/Yes	Yes

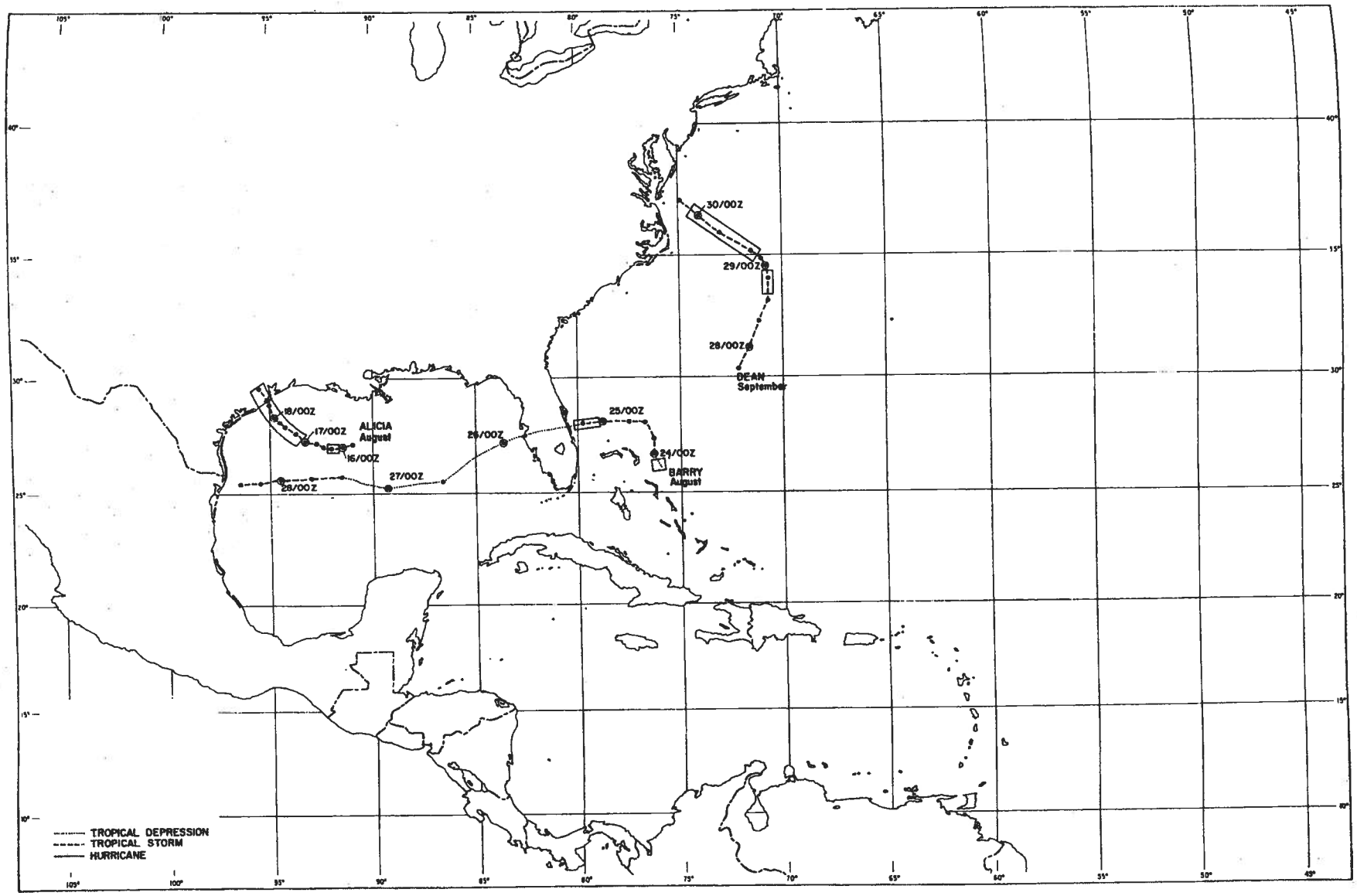

Fig. 29. Best-track plots for Atlantic storms investigated by HRD during the 1983 hurricane season.

8.2 1983 Missions

STORM NAME	DATE(S) FLOWN	MISSION(S) IDENT.	TYPE[6]	REMARKS[7,8]	FIGURES
ALICIA	16 Aug 1983	830816H	LTM/R	Gulf Mex	29,30
	17 Aug 1983	830817I1	LTM/VE		29,31
	17 Aug 1983	830817H	LTM/VE		29,32
	17 Aug 1983	830817I2	LTM/VE		29,33,34
	18 Aug 1983	830818H	LTM/VE		29,35

Hurricane ALICIA (15-21 August 1983): Alicia was the first hurricane since Allen (1980) to make landfall in the continental United States. It was also one of the costliest in Texas history. Alicia caused widespread damage to a large portion of southeast Texas, including coastal areas near Galveston and the entire Houston area.

The system that eventually became Alicia formed on the extreme western end of a frontal trough that extended from the New England coast southwestward over the north-central Gulf of Mexico. On 15 August Alicia slowly moved west, then northwest, intensifying to hurricane strength before making landfall on the western end of Galveston Island. Slow to weaken during landfall, Alicia gradually lost strength once inland. It moved through Texas, Oklahoma, and Kansas before becoming disorganized in Nebraska on 21 August. [National Climatic Center, 1983a.]

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6. LTM: Long-term monitoring experiment.
R: Reconnaissance (NHC) and research (HRD) mission objectives.
VE: Vortex evolution option.

7. Digitized, land-based radar data were obtained by HRD and NWSTC personnel at NWS sites (GLS and CRP). These data support the objectives of the land-based radar, landfalling storm, and Hurricane Strike programs.

8. Special RAOB data were also obtained from NWS upper air stations in the vicinity of the storm's landfall on the Texas-Gulf Coast to support this research (table 9).

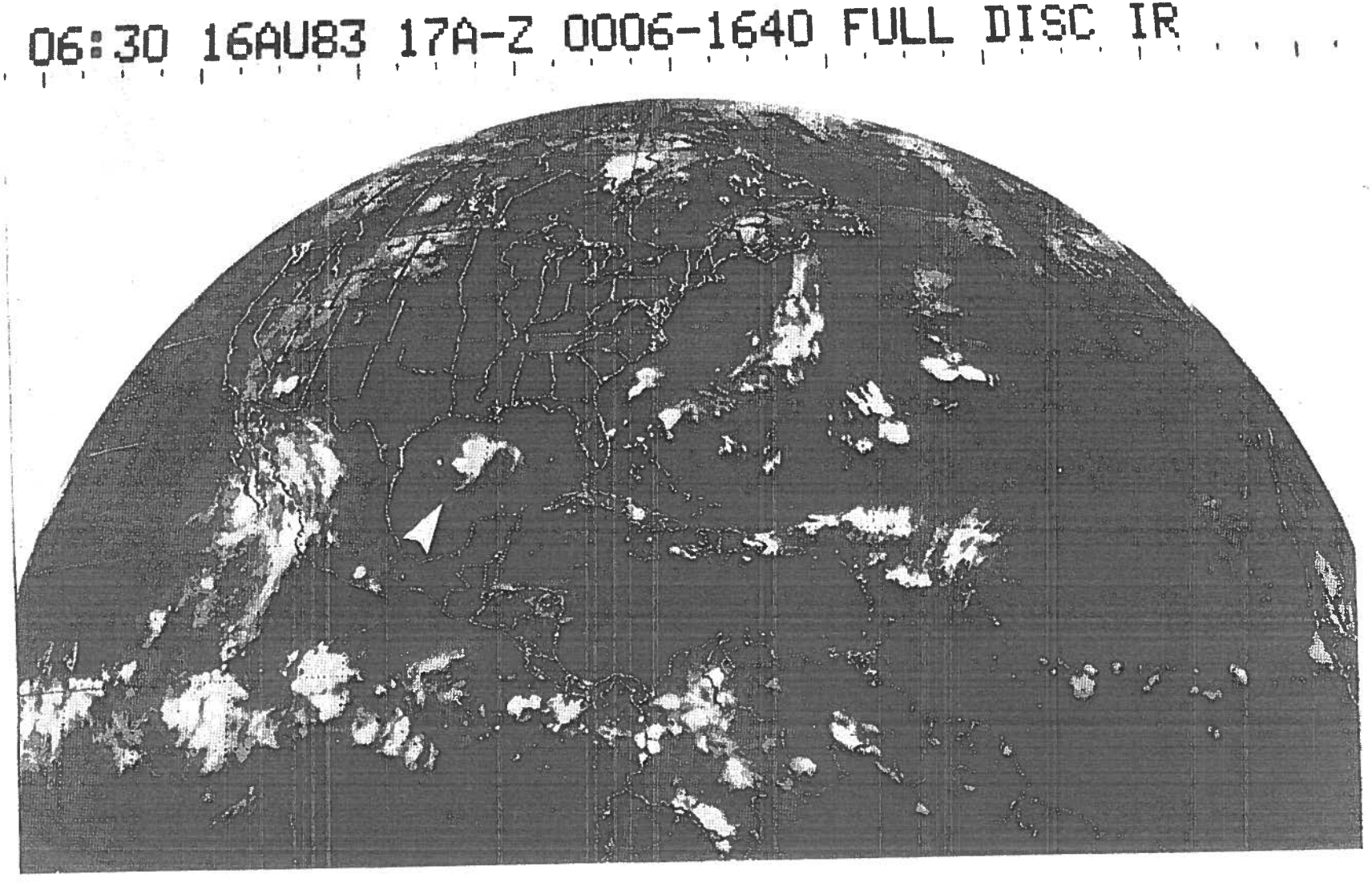

Fig. 30. ALICIA (16 August 1983/0630 GMT) GOES-EAST/FULL DISC IR.

FLIGHT LOG

Date:	August 16, 1983
Flight Identification:	830816H
Aircraft:	WP-3D/N42RF
Departed:	Miami, Florida, at 16/0328 GMT
Arrived:	Miami, Florida, at 16/0945 GMT
Purpose:	Reconnaissance (NHC)/research (HRD) - T. S. ALICIA.
Pattern:	See Figs. 4 and 5 (pattern III); altitude 1.5 K ft. Single-aircraft mission followed by four successive flights after hurricane development.

FILM LOG

Camera	Roll	From [Day/Time (GMT)]	To [Day/Time (GMT)]

NO FILM TAKEN

TAPE LOG: 830816H

Tape Type	Number	From [Day/Time (GMT)]	To [Day/Time (GMT)]
RFC Standard	1/1	16/0328	16/0945
Radar	1/5	16/0500	16/0533
Radar	2/5	16/0533	16/0609
Radar	3/5	16/0609	16/0647
Radar	4/5	16/0647	16/0727
Radar	5/5	16/0727	16/0814
Slow	1/1	16/0328	16/0945

EQUIPMENT STATUS: 830816H

SYSTEM	STATUS /	UP	DOWN	NOT USED	REMARKS
NAV	INE 1	X			Free-running (see ONE)
	INE 2	X			
	ONE	X			Failed at takeoff
	DOPL	X			
RADAR	NOSE			X	
	LF	X			
	TAIL	X			
	DOPPLER			X	
	DATA SYSTEM	X			0350 GMT threshold prob.
RAMS	DATA SYSTEM	X			3 parity err. 1st 134 ft
	TOTAL TEMP. 1	X			
	TOTAL TEMP. 2	X			
	DEW POINT	X			
	ATTACK ANGLE	X			
	SLIP ANGLE	X			
	ABS. PRESS.	X			
	DIFF. PRESS.	X			
	RADAR ALT.	X			
	J & W	X			
PMS	OAP 2DP			X	
	OAP 2DC			X	
	FSSP 100			X	
	DATA SYSTEM			X	
IPC				X	
FOIL				X	
CO_2 RADIOMETER				X	
MICRO. RADIOMETER				X	
SFC. RADIOMETER		X			
FORMVAR				X	
PHOTOGRAPHY	FWD			X	
	LS			X	
	RS			X	
	DWN			X	
AXBT	TUBES			X	
	RECEIVERS			X	
ODW				X	

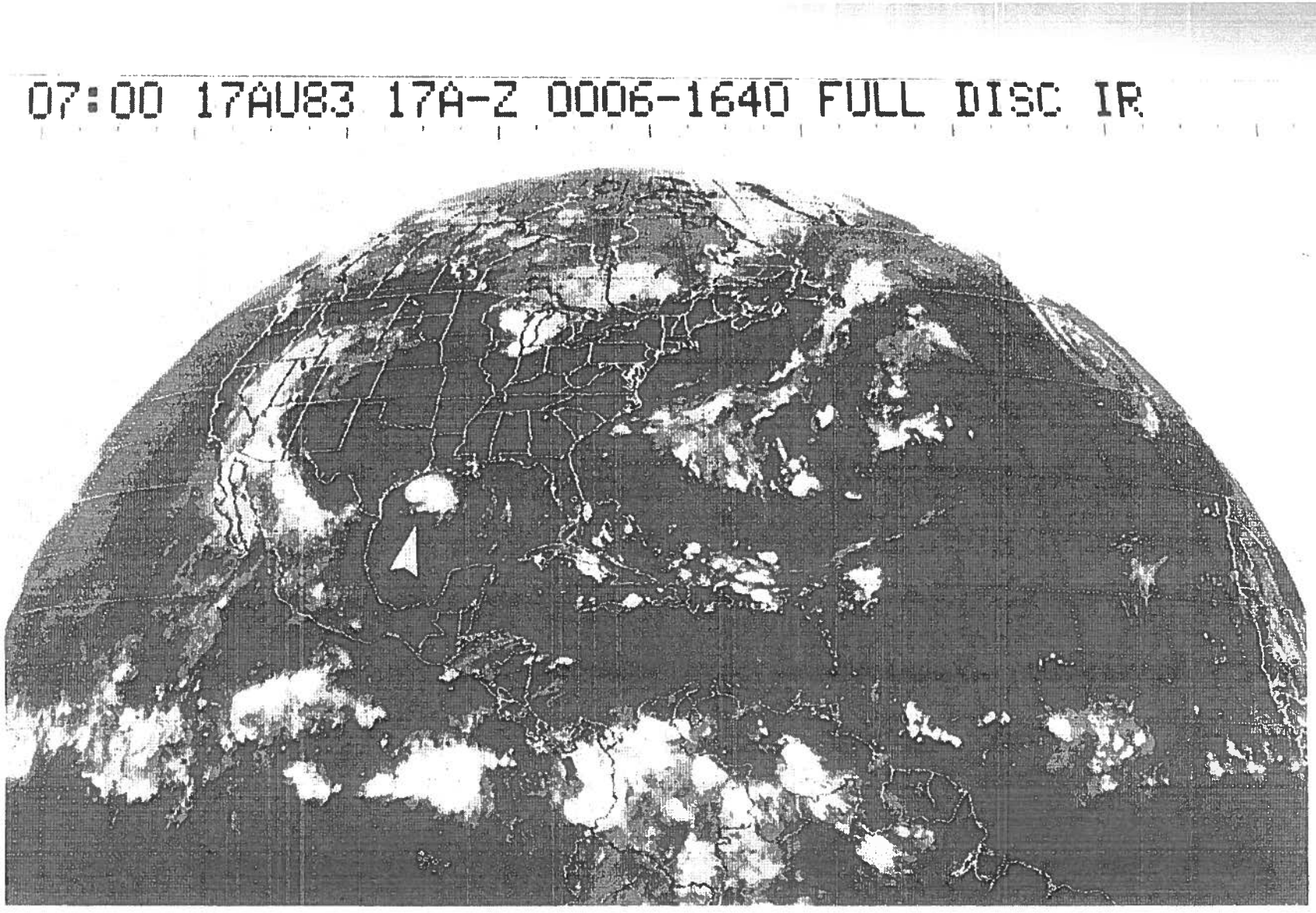

Fig. 31. ALICIA (17 August 1983/0700 GMT) GOES-EAST/FULL DISC IR.

FLIGHT LOG

Date:	August 17, 1983
Flight Identification:	830817I1
Aircraft:	WP-3D/N43RF
Departed:	Miami, Florida, at 17/0100 GMT
Arrived:	New Orleans, Louisiana, at 17/1015 GMT
Purpose:	Reconnaissance (NHC)/research (HRD) - Hurricane ALICIA.
Pattern:	See Fig. 4/Vortex Evolution (pattern I) option 1 (modified); altitude 5 K ft. Single-aircraft mission (one of four) with six passes flown. Pattern modification due to proximity of land.

FILM LOG

Camera	Roll	From [Day/Time (GMT)]	To [Day/Time (GMT)]

NO FILM TAKEN

TAPE LOG: 830817I1

Tape Type	Number	From [Day/Time (GMT)]	To [Day/Time (GMT)]
RFC Standard	1/01	17/0052	17/1016
Radar	1/13	17/0337	17/0401
Radar	2/13	17/0401	17/0431
Radar	3/13	17/0431	17/0501
Radar	4/13	17/0501	17/0532
Radar	5/13	17/0534	17/0552
Radar	6/13	17/0552	17/0613
Radar	7/13	17/0613	17/0643
Radar	8/13	17/0643	17/0707
Radar	9/13	17/0707	17/0739
Radar	10/13	17/0739	17/0800
Radar	11/13	17/0800	17/0832
Radar	12/13	17/0832	17/0902
Radar	13/13	17/0902	17/0933
Knollenberg	1/18	17/0147	17/0355
Knollenberg	2/18	17/0355	17/0421
Knollenberg	3/18	17/0421	17/0507
Knollenberg	4/18	17/0507	17/0534
Knollenberg	5/18	17/0534	17/0559
Knollenberg	6/18	17/0559	17/0622
Knollenberg	7/18	17/0622	17/0640
Knollenberg	8/18	17/0640	17/0656
Knollenberg	9/18	17/0656	17/0703
Knollenberg	10/18	17/0703	17/0731
Knollenberg	11/18	17/0731	17/0738
Knollenberg	12/18	17/0748	17/0806
Knollenberg	13/18	17/0806	17/0814
Knollenberg	14/18	17/0814	17/0856
Knollenberg	15/18	17/0856	17/0908
Knollenberg	16/18	17/0908	17/0923
Knollenberg	17/18	17/0923	17/0932
Knollenberg	18/18	17/0932	17/0939
Slow	1/01	17/0052	17/1016
Doppler	1/11	17/0339	17/0358
Doppler	2/11	17/0403	17/0430
Doppler	3/11	17/0516	17/0535
Doppler	4/11	17/0551	17/0611
Doppler	5/11	17/0617	17/0641
Doppler	6/11	17/0651	17/0705
Doppler	7/11	17/0711	17/0759
Doppler	8/11	17/0802	17/0816
Doppler	9/11	17/0818	17/0837
Doppler	10/11	17/0848	17/0901
Doppler	11/11	17/0903	17/0917

EQUIPMENT STATUS: 83081711

SYSTEM	STATUS /	UP	DOWN	NOT USED	REMARKS
NAV	INE 1	X			
	INE 2	X			
	ONE	X			
	DOPL	X			
RADAR	NOSE			X	
	LF	X			0125 GMT sync. fail; fixed
	TAIL	X			
	DOPPLER	X			Marginal
	DATA SYSTEM	X			Time code defective
RAMS	DATA SYSTEM	X			0825 GMT CPU1 break
	TOTAL TEMP. 1	X			
	TOTAL TEMP. 2	X			
	DEW POINT	X			
	ATTACK ANGLE	X			
	SLIP ANGLE	X			
	ABS. PRESS.	X			
	DIFF. PRESS.	X			
	RADAR ALT.	X			
	J & W	X			
PMS	OAP 2DP	X			
	OAP 2DC	X			
	FSSP 100	X			Counts in channels 0 & 4 only
	DATA SYSTEM	X			0731 GMT format break
IPC				X	
FOIL				X	
CO_2 RADIOMETER				X	
MICRO. RADIOMETER				X	
SFC. RADIOMETER		X			
FORMVAR				X	
PHOTOGRAPHY	FWD			X	
	LS			X	
	RS			X	
	DWN			X	
AXBT	TUBES			X	
	RECEIVERS			X	
ODW				X	

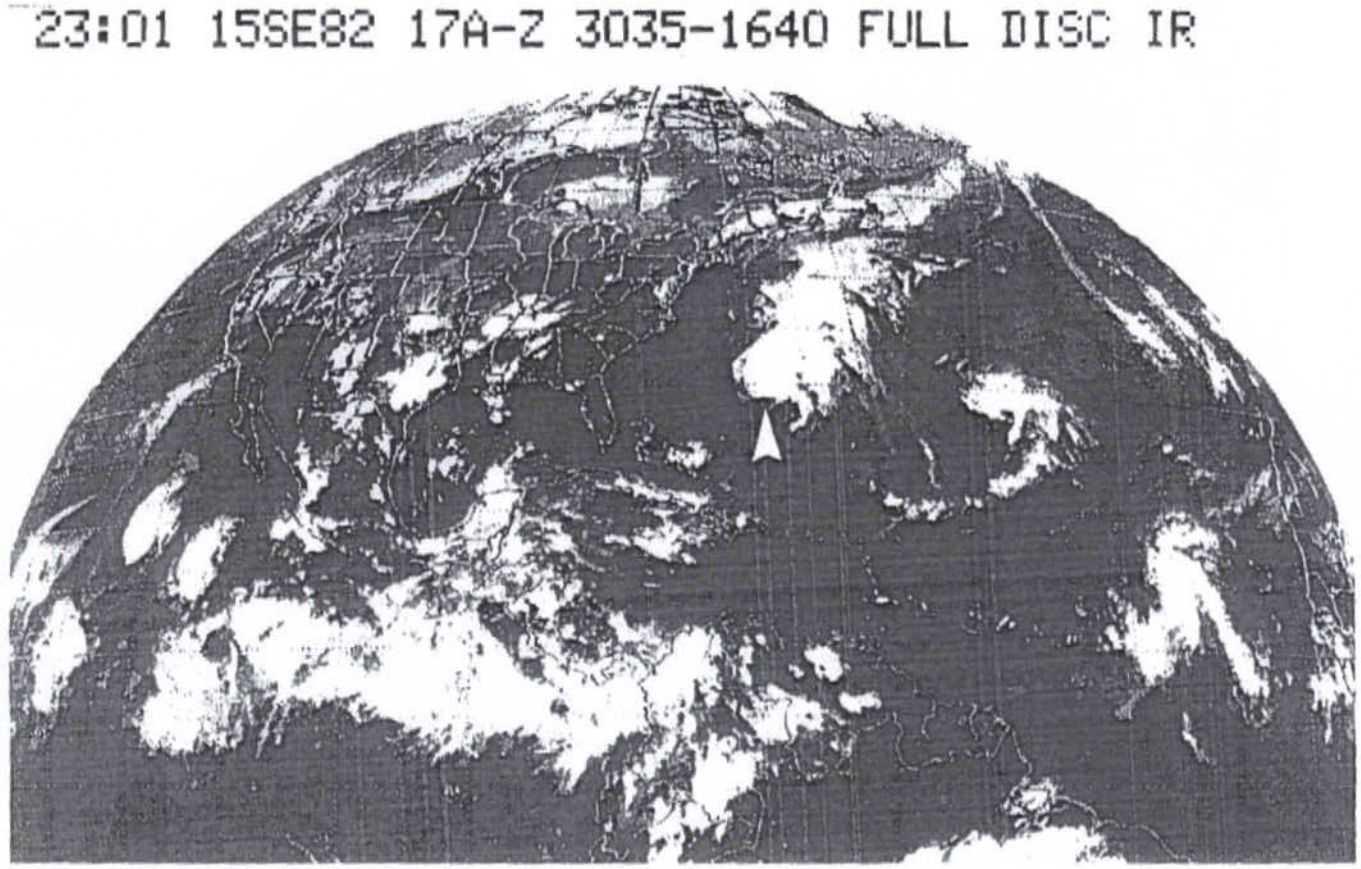

Fig. 23. DEBBY (15 September 1982/2301 GMT) GOES-EAST/FULL DISC IR.

FLIGHT LOG

Date:	August 17, 1983
Flight Identification:	830817H
Aircraft:	WP-3D/N42RF
Departed:	Miami, Florida, at 17/0911 GMT
Arrived:	Miami, Florida, at 17/1914 GMT
Purpose:	Reconnaissance (NHC)/research (HRD) - Hurricane ALICIA.
Pattern:	See Fig. 4/Vortex Evolution (pattern I) option 1 (modified); altitude 5 K ft. Single-aircraft mission (two of four) with seven passes flown. Pattern modification due to proximity to land.

FILM LOG

Camera	Roll	From [Day/Time (GMT)]	To [Day/Time (GMT)]
Forward	1/1	17/0911	17/1914
Left-side	1/1	17/0911	17/1914
Right-side	1/1	17/0911	17/1914

TAPE LOG: 830817H

Tape Type	Number	From [Day/Time (GMT)]	To [Day/Time (GMT)]
RFC Standard	1/01	17/0815	17/1914
Radar	1/10	17/1145	17/1221
Radar	2/10	17/1221	17/1300
Radar	3/10	17/1300	17/1341
Radar	4/10	17/1342	17/1420
Radar	5/10	17/1420	17/1459
Radar	6/10	17/1500	17/1539
Radar	7/10	17/1539	17/1620
Radar	8/10	17/1621	17/1659
Radar	9/10	17/1700	17/1747
Radar	10/10	17/1747	17/1858
Knollenberg	1/16	17/NA*	17/NA
Knollenberg	2/16	17/NA	17/NA
Knollenberg	3/16	17/NA	17/NA
Knollenberg	4/16	17/NA	17/NA
Knollenberg	5/16	17/NA	17/NA
Knollenberg	6/16	17/NA	17/NA
Knollenberg	7/17	17/NA	17/NA
Knollenberg	8/16	17/NA	17/NA
Knollenberg	9/16	17/NA	17/NA
Knollenberg	10/16	17/NA	17/NA
Knollenberg	11/16	17/NA	17/NA
Knollenberg	12/16	17/NA	17/NA
Knollenberg	13/16	17/NA	17/NA
Knollenberg	14/16	17/NA	17/NA
Knollenberg	15/16	17/NA	17/NA
Knollenberg	16/16	17/NA	17/NA
Slow	1/01	17/0815	17/1914

*NA = information not available at time of printing.

EQUIPMENT STATUS: 830817H

SYSTEM	STATUS /	UP	DOWN	NOT USED	REMARKS
NAV	INE 1	X			
	INE 2	X			
	ONE	X			
	DOPL	X			
RADAR	NOSE			X	
	LF	X			1455 GMT temp. tilt prob.
	TAIL	X			1725 GMT antenna stops
	DOPPLER			X	
	DATA SYSTEM	X			
RAMS	DATA SYSTEM	X			1640 GMT/Ramtek brkg. up
	TOTAL TEMP. 1	X			
	TOTAL TEMP. 2	X			
	DEW POINT	X			
	ATTACK ANGLE	X			
	SLIP ANGLE	X			
	ABS. PRESS.	X			
	DIFF. PRESS.	X			
	RADAR ALT.	X			
	J & W	X			
PMS	OAP 2DP	X			
	OAP 2DC	X			0930 GMT update continuous
	FSSP 100	X			
	DATA SYSTEM	X			
IPC				X	
FOIL				X	
CO_2 RADIOMETER				X	
MICRO. RADIOMETER				X	
SFC. RADIOMETER			X		
FORMVAR				X	
PHOTOGRAPHY	FWD	X			
	LS	X			
	RS	X			
	DWN			X	
AXBT	TUBES			X	
	RECEIVERS			X	
ODI				X	

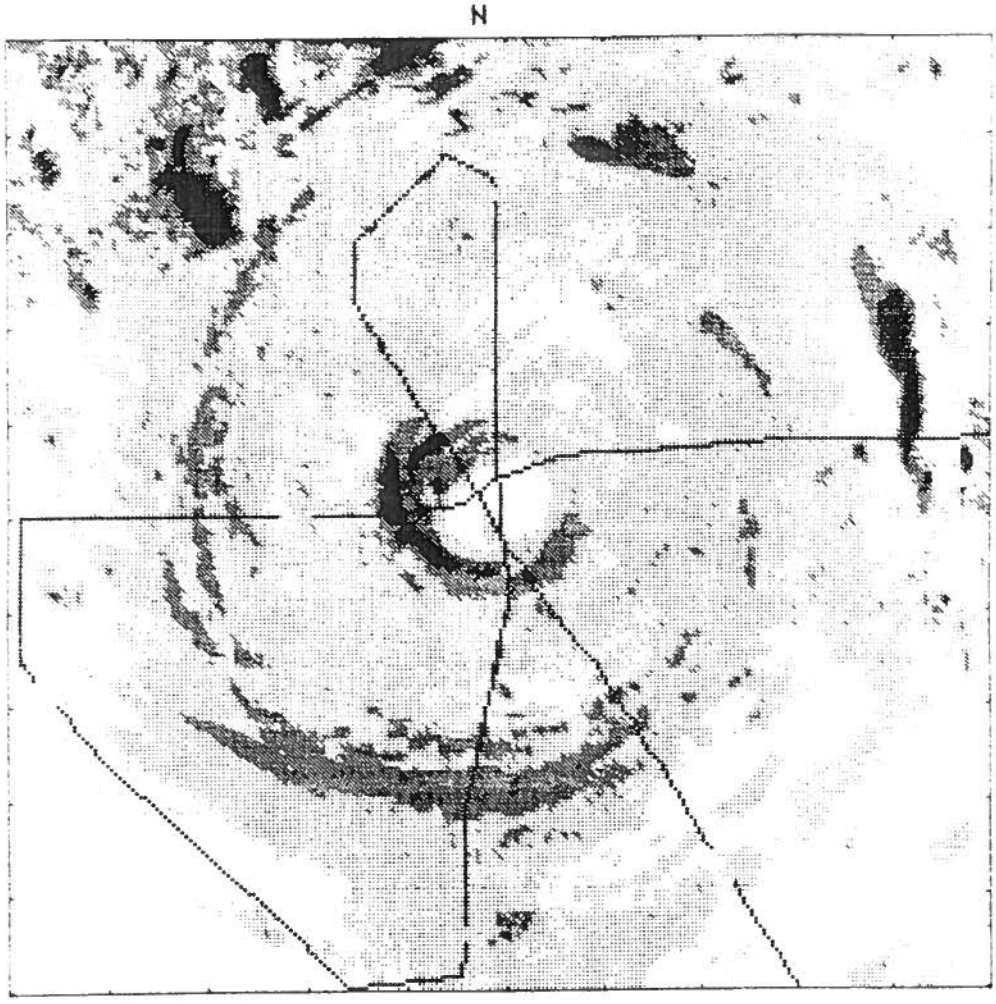

Fig. 33. Hurricane ALICIA, flight 830817I2, 203834-232112 GMT: Lower fuselage radar time composite and aircraft track.

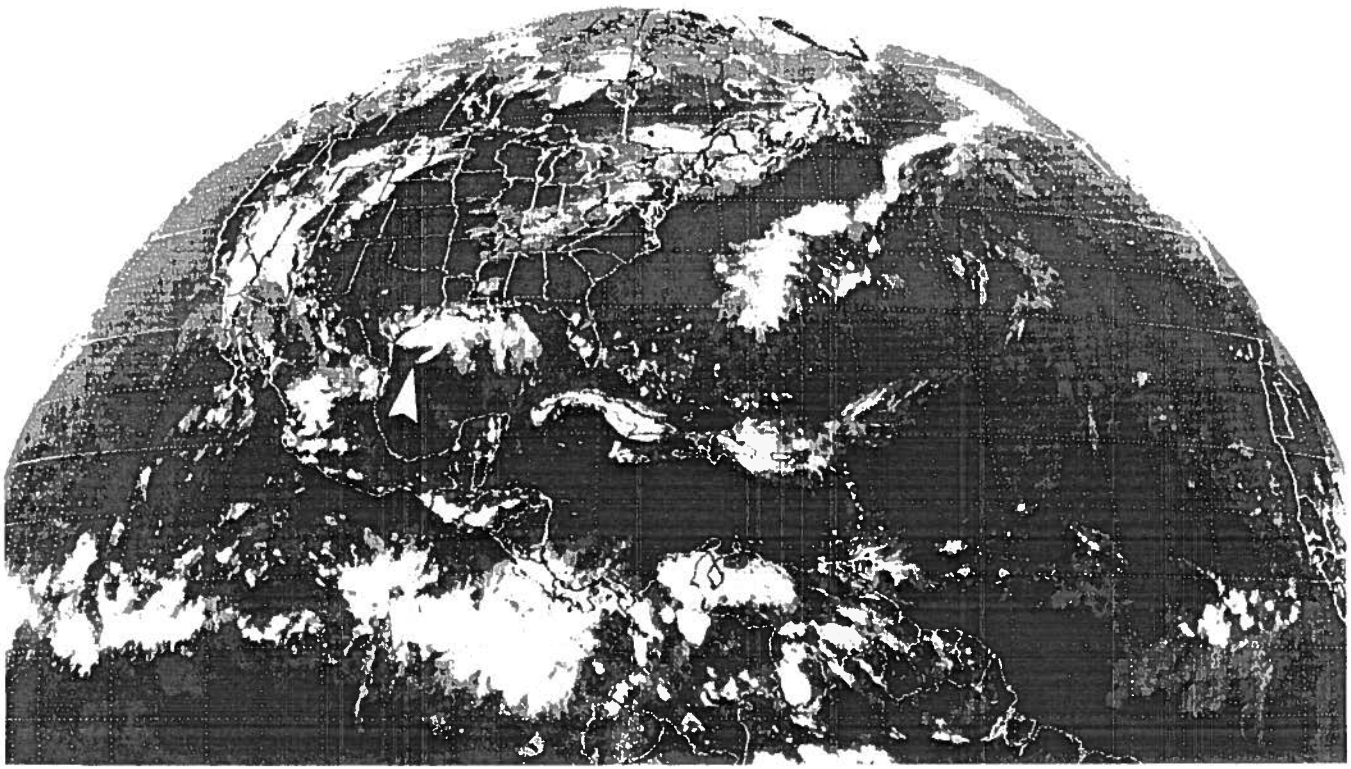

Fig. 34. ALICIA (18 August 1983/0001 GMT) GOES-EAST/FULL DISC IR.

FLIGHT LOG

Date:	August 17, 1983
Flight Identification:	830817I2
Aircraft:	WP-3D/N43RF
Departed:	New Orleans, Louisiana, at 17/1935 GMT
Arrived:	New Orleans, Louisiana, at 18/0440 GMT
Purpose:	Reconnaissance (NHC)/research (HRD) - Hurricane ALICIA.
Pattern:	See Fig. 4/Vortex Evolution (pattern I) option 1 (modified); altitude 5 K ft. Single-aircraft mission (three of four) with seven passes flown. Pattern modification due to proximity to land; outer rainband investigation southeast of center.

FILM LOG

Camera	Roll	From [Day/Time (GMT)]	To [Day/Time (GMT)]
Forward	1/1	17/1934	18/0439
Left-side	1/1	17/1934	18/0439
Down		40 frames 60 mm film	

TAPE LOG: 83081712

Tape Type	Number	From [Day/Time (GMT)]	To [Day/Time (GMT)]
RFC Standard	1/01	17/1934	18/0439
Radar	1/18	17/1954	17/2023
Radar	2/18	17/2023	17/2041
Radar	3/18	17/2041	17/2110
Radar	4/18	17/2110	17/2133
Radar	5/18	17/2133	17/2154
Radar	6/18	17/2154	17/2223
Radar	7/18	17/2223	17/2252
Radar	8/18	17/2252	17/2322
Radar	9/18	17/2322	17/2340
Radar	10/18	17/2340	18/0009
Radar	11/18	18/0009	18/0034
Radar	12/18	18/0034	18/0106
Radar	13/18	18/0106	18/0139
Radar	14/18	18/0139	18/0210
Radar	15/18	18/0210	18/0237
Radar	16/18	18/0237	18/0308
Radar	17/18	18/0311	18/0341
Radar	18/18	18/0346	18/0416
Knollenberg	1/23	17/1923	17/2042
Knollenberg	2/23	17/2042	17/2058
Knollenberg	3/23	17/2058	17/2113
Knollenberg	4/23	17/2113	17/2154
Knollenberg	5/23	17/2154	17/2205
Knollenberg	6/23	17/2205	17/2222
Knollenberg	7/23	17/2222	17/2234
Knollenberg	8/23	17/2234	17/2239
Knollenberg	9/23	17/2240	17/2357
Knollenberg	10/23	17/2357	18/0004
Knollenberg	11/23	18/0004	18/0027
Knollenberg	12/23	18/0027	18/0059
Knollenberg	13/23	18/0059	18/0117
Knollenberg	14/23	18/0117	18/0122
Knollenberg	15/23	18/0122	18/0142
Knollenberg	16/23	18/0142	18/0149
Knollenberg	17/23	18/0149	18/0203
Knollenberg	18/23	18/0203	18/0246
Knollenberg	19/23	18/0246	18/0301
Knollenberg	20/23	18/0302	18/0315
Knollenberg	21/23	18/0315	18/0332
Knollenberg	22/23	18/0332	18/0340
Knollenberg	23/23	18/0340	18/0418
Slow	1/01	17/1934	18/0439

TAPE LOG: 830817I2

Tape Type	Number	From [Day/Time (GMT)]	To [Day/Time (GMT)]
Doppler	1/22	17/2023	17/2041
Doppler	2/22	17/2043	17/2100
Doppler	3/22	17/2107	17/2111
Doppler	4/22	17/2112	17/2131
Doppler	5/22	17/2135	17/2153
Doppler	6/22	17/2157	17/2217
Doppler	7/22	17/2220	17/2238
Doppler	8/22	17/2240	17/2259
Doppler	9/22	17/2302	17/2321
Doppler	10/22	17/2323	17/2340
Doppler	11/22	17/2343	17/2355
Doppler	12/22	17/2356	18/0013
Doppler	13/22	18/0015	18/0033
Doppler	14/22	18/0036	18/0053
Doppler	15/22	18/0056	18/0115
Doppler	16/22	18/0118	18/0136
Doppler	17/22	18/0139	18/0158
Doppler	18/22	18/0201	18/0220
Doppler	19/22	18/0223	18/0242
Doppler	20/22	18/0245	18/0304
Doppler	21/22	18/0307	18/0326
Doppler	22/22	18/0328	18/0348

EQUIPMENT STATUS: 830817I2

SYSTEM	STATUS /	UP	DOWN	NOT USED	REMARKS
NAV	INE 1	X			Free run from T/O
	INE 2	X			Free run from T/O
	ONE	X			Flown unaided-No Omega
	DOPL	X			
RADAR	NOSE			X	
	LF	X			
	TAIL	X			
	DOPPLER	X			
	DATA SYSTEM	X			Time code problem
RAMS	DATA SYSTEM	X			CPU1 down 5+ times
	TOTAL TEMP. 1	X			
	TOTAL TEMP. 2	X			
	DEW POINT	X			
	ATTACK ANGLE	X			
	SLIP ANGLE	X			
	ABS. PRESS.	X			
	DIFF. PRESS.	X			
	RADAR ALT.	X			
	J & W	X			
PMS	OAP 2DP	X			
	OAP 2DC	X			
	FSSP 100			X	Laser inoperable
	DATA SYSTEM	X			
IPC				X	
FOIL				X	
CO_2 RADIOMETER				X	
MICRO. RADIOMETER				X	
SFC. RADIOMETER		X			
FORMVAR				X	
PHOTOGRAPHY	FWD	X			Water damage in flt.
	LS	X			
	RS			X	
	DWN	X			40 frames/Hasselblad
AXBT	TUBES			X	
	RECEIVERS			X	
ODW				X	

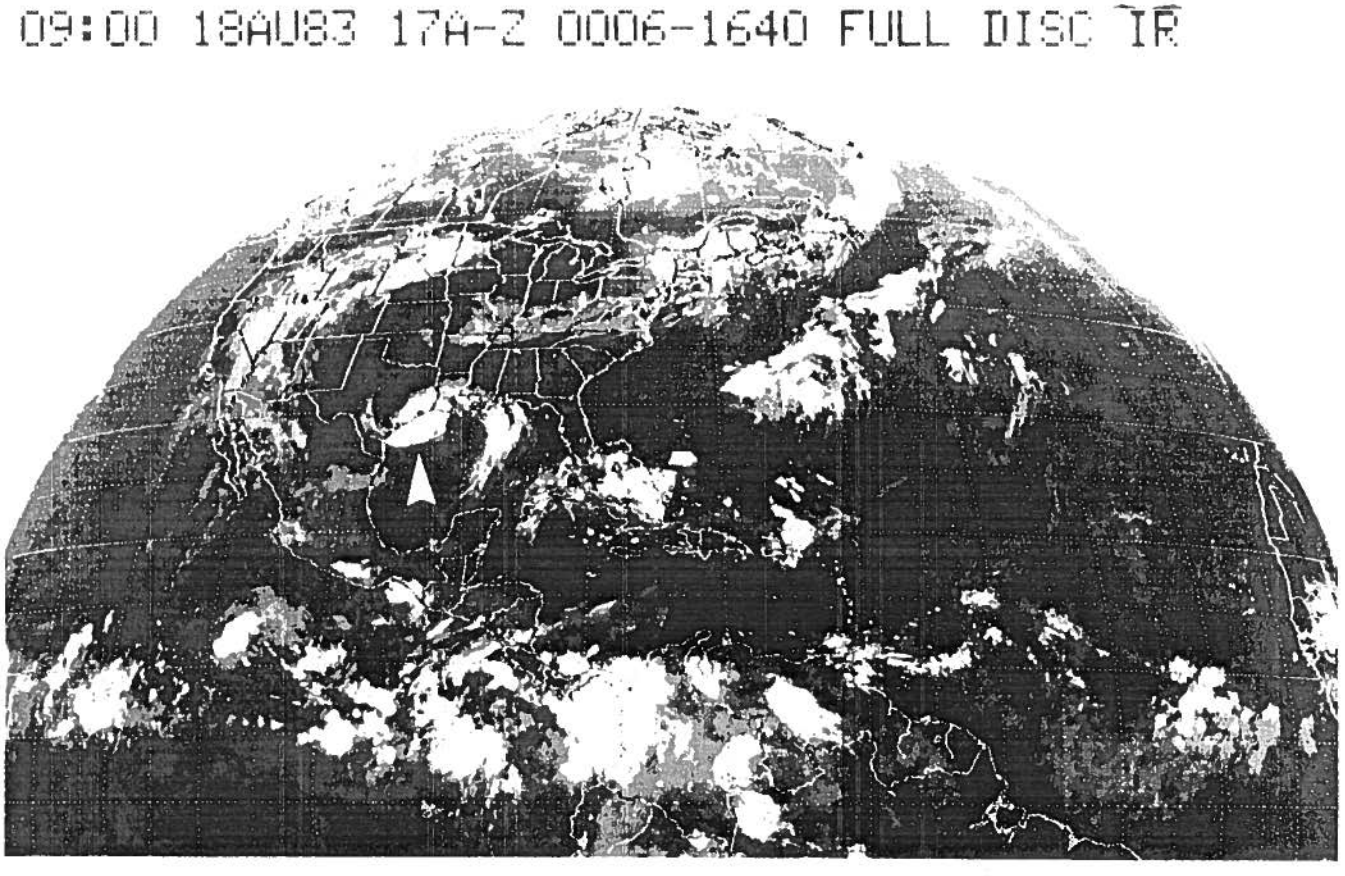

Fig. 35. ALICIA (18 August 1983/0900 GMT) GOES-EAST/FULL DISC IR.

FLIGHT LOG

Date:	August 18, 1983
Flight Identification:	830818H
Aircraft:	WP-3D/N42RF
Departed:	New Orleans, Louisiana, at 18/0500 GMT
Arrived:	New Orleans, Louisiana, at 18/1255 GMT
Purpose:	Reconnaissance (NHC)/research (HRD) - Hurricane ALICIA.
Pattern:	See Fig. 4/Vortex Evolution (pattern I) option 1 (modified); altitude 5 K ft. Single-aircraft mission (four of four) with multiple passes through or near the storm center. Pattern modified due to storm landfall.

FILM LOG

Camera	Roll	From [Day/Time (GMT)]	To [Day/Time (GMT)]

NO FILM TAKEN

TAPE LOG: 830818H

Tape Type	Number	From [Day/Time (GMT)]	To [Day/Time (GMT)]
RFC Standard	1/01	18/0510	18/1258
Radar	1/08	18/0601	18/0716
Radar	2/08	18/0716	18/0755
Radar	3/08	18/0755	18/0836
Radar	4/08	18/0850	18/0930
Radar	5/08	18/0930	18/1008
Radar	6/08	18/1008	18/1048
Radar	7/08	18/1048	18/1133
Radar	8/08	18/1133	18/1213
Knollenberg	1/14	18/0606	18/0616
Knollenberg	2/14	18/0616	18/0633
Knollenberg	3/14	18/0633	18/0643
Knollenberg	4/14	18/0643	18/0723
Knollenberg	5/14	18/0723	18/0802
Knollenberg	6/14	18/0802	18/0836
Knollenberg	7/14	18/0836	18/0928
Knollenberg	8/14	18/0928	18/0949
Knollenberg	9/14	18/0949	18/1004
Knollenberg	10/14	18/1004	18/1035
Knollenberg	11/14	18/1035	18/1046
Knollenberg	12/14	18/1046	18/1120
Knollenberg	13/14	18/1120	18/1149
Knollenberg	14/14	18/1149	18/1200
Slow	1/01	18/0510	18/1258

EQUIPMENT STATUS: 830818H

SYSTEM	STATUS /	UP	DOWN	NOT USED	REMARKS
NAV	INE 1	X			0710 GMT free-running
	INE 2	X			
	ONE	X			0717 GMT INE #1 discon.
	DOPL	X			
RADAR	NOSE			X	
	LF	X			
	TAIL	X			
	DOPPLER			X	
	DATA SYSTEM	X			
RAMS	DATA SYSTEM	X			0720, 0930 GMT CPU brk.
	TOTAL TEMP. 1	X			
	TOTAL TEMP. 2	X			
	DEW POINT	X			
	ATTACK ANGLE	X			
	SLIP ANGLE	X			
	ABS. PRESS.	X			
	DIFF. PRESS.	X			
	RADAR ALT.	X			
	J & W		X		Inop.
PMS	OAP 2DP	X			0536 GMT inop.
	OAP 2DC	X			0520 GMT part array fail.
	FSSP 100	X			
	DATA SYSTEM	X			
IPC				X	
FOIL				X	
CO_2 RADIOMETER				X	
MICRO. RADIOMETER				X	
SFC. RADIOMETER		X			
FORMVAR				X	
PHOTOGRAPHY	FWD			X	
	LS			X	
	RS			X	
	DWN			X	
AXBT	TUBES			X	
	RECEIVERS			X	
ODW				X	

Table 9. ALICIA RAOB data set

YrMoDa/Hr (GMT)	RAOB Stations[1] LCH	BRO	VCT	BVE
830816/00	N	N	Y	N
/03	N	N	N	N
/06	N	N	N	N
/09	N	N	N	N
830816/12	Y	Y	Y	N
/15	N	N	N	N
/18	Y	Y	Y	Y
/21	Y	N	N	N
830817/00	Y	Y	Y	Y
/03	Y	Y	Y	N
/06	Y	Y	Y	Y
/09	Y	Y	Y	N
830817/12	Y	Y	Y	Y
/15	Y	Y	Y	N
/18	Y	Y	Y	Y
/21	Y	Y	Y	N
830818/00	Y	Y	Y	Y
/03	Y	Y	Y	N
/06	Y	Y	Y	Y
/09	Y	Y	Y	N
830818/12	Y	Y	Y	Y
/15	N	Y	Y	N
/18	Y	Y	Y	Y
/21	N	N	N	N
830819/00	N	N	Y	Y

[1] LCH: Station No. 72240 -- NWS/WSO, Lake Charles, Louisiana.

BRO: Station No. 72250 -- NWS/WSO, Brownsville, Texas.

VCT: Station No. 72255 -- NWS/WSO, Victoria, Texas.

BVE: Station No. 72232 -- NWS/WSCMO (Weather Service Contract Meteorological Observatory), Boothville, Louisiana.

Y: Data available at HRD/AOML.

N: No data.

STORM NAME	DATE(S) FLOWN	MISSION(S) IDENT.	TYPE[9]	REMARKS	FIGURES
BARRY	23 Aug 1983	830823I	LTM/R/VE	Atlantic	29,36
	25 Aug 1983	830825H	LTM/R/VE		29,37

Hurricane BARRY (23-29 August 1983): Barry formed from a tropical disturbance in the Atlantic Ocean and became a tropical storm near the Bahamas as it turned westward toward Florida. On 25 August Barry made landfall and weakened as it crossed the Florida peninsula and moved into the Gulf of Mexico. Continuing westward, Barry reintensified and became a hurricane just before making a second landfall. Barry went ashore in Mexico on 28 August and quickly dissipated as it moved inland. Barry caused only minimal damage in Florida and Texas. Some structural damage and road washouts occurred in Mexico. [National Climatic Center, 1983a; Gerrish and Case, 1984.]

9. LTM: Long-term monitoring.
R: Reconnaissance (NHC) and research (HRD) mission objectives.
VE: Vortex evolution option.

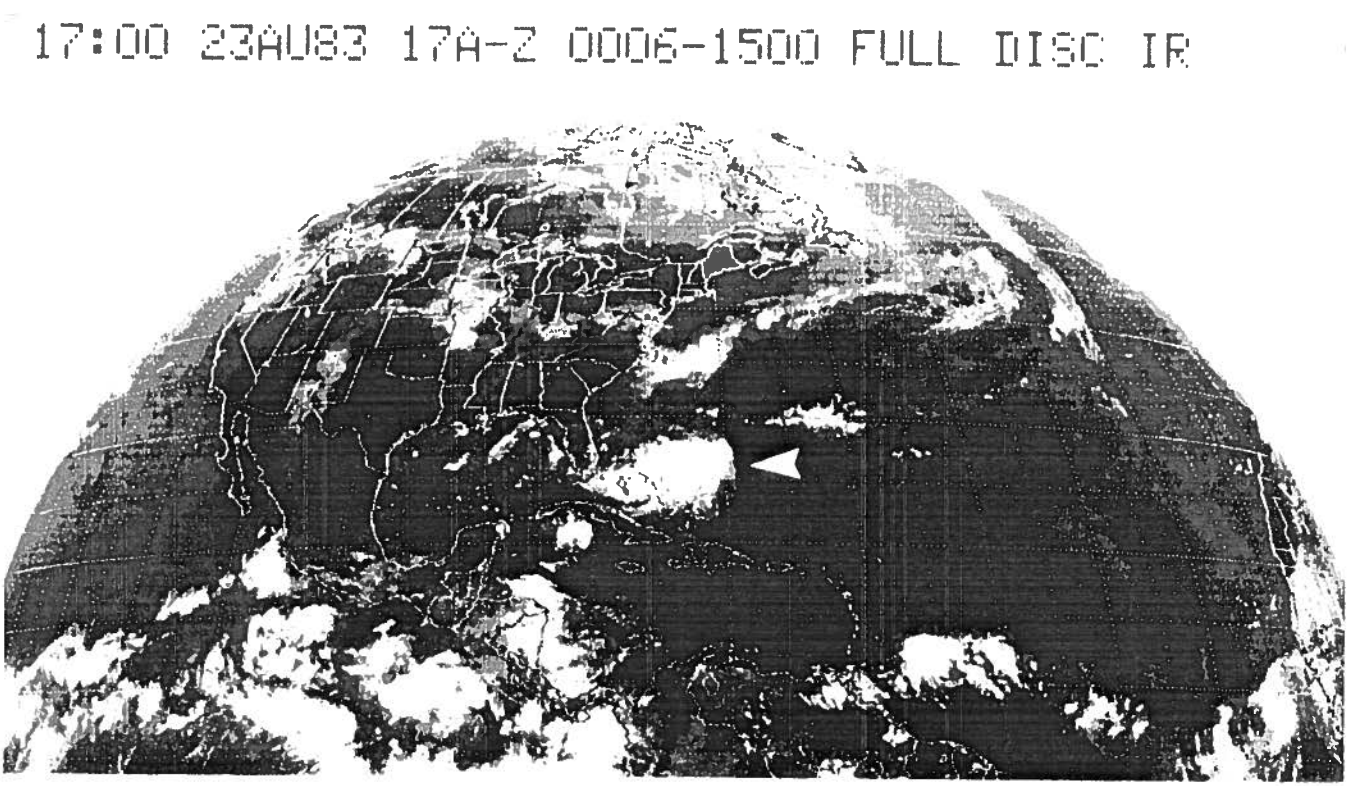

Fig. 36. BARRY (23 August 1983/1700 GMT) GOES-EAST/FULL DISC IR.

FLIGHT LOG

Date:	August 23, 1983
Flight Identification:	830823I
Aircraft:	WP-3D/N43RF
Departed:	Miami, Florida, at 23/1100 GMT
Arrived:	Miami, Florida, at 23/2105 GMT
Purpose:	Reconnaissance (NHC)/research (HRD) - pre-T. S. BARRY.
Pattern:	See Fig. 4/Vortex Evolution (pattern I) option 1 (modified); altitude 5 K ft. Single-aircraft mission with multiple passes flown in or near storm center. Pattern modified due to poor eye definition.

FILM LOG

Camera	Roll	From [Day/Time (GMT)]	To [Day/Time (GMT)]
Left-side	1/1	23/1130	23/2100
Right-side	1/1	23/1130	23/2100

TAPE LOG: 830823I

Tape Type	Number	From [Day/Time (GMT)]	To [Day/Time (GMT)]
RFC Standard	1/1	23/1100	23/2100
Radar	1/5	23/1142	23/1425
Radar	2/5	23/1615	23/1741
Radar	3/5	23/1741	23/1914
Radar	4/5	23/1914	23/1945
Radar	5/5	23/1945	23/2011
Knollenberg	1/8	23/1300	23/1328
Knollenberg	2/8	23/1328	23/1418
Knollenberg	3/8	23/1418	23/1543
Knollenberg	4/8	23/1543	23/1650
Knollenberg	5/8	23/1650	23/1748
Knollenberg	6/8	23/1748	23/1818
Knollenberg	7/8	23/1818	23/1901
Knollenberg	8/8	23/1901	23/2014
Slow	1/1	23/1100	23/2100
Doppler	1/3	23/1637	23/1653
Doppler	2/3	23/1811	23/1828
Doppler	3/3	23/1917	23/1934

EQUIPMENT STATUS: 830823I

SYSTEM	STATUS /	UP	DOWN	NOT USED	REMARKS
NAV	INE 1	X			
	INE 2	X			
	ONE	X			
	DOPL	X			
RADAR	NOSE			X	
	LF	X			
	TAIL	X			
	DOPPLER	X			
	DATA SYSTEM	X			
RAMS	DATA SYSTEM	X			1220 GMT PE 1718, 1956 GMT brk.
	TOTAL TEMP. 1	X			
	TOTAL TEMP. 2	X			
	DEW POINT	X			
	ATTACK ANGLE	X			
	SLIP ANGLE	X			
	ABS. PRESS.	X			
	DIFF. PRESS.	X			
	RADAR ALT.	X			
	J & W	X			
PMS	OAP 2DP	X			
	OAP 2DC	X			1140 GMT clear air updt.
	FSSP 100	X			
	DATA SYSTEM	X			
IPC				X	
FOIL				X	
CO_2 RADIOMETER				X	
MICRO. RADIOMETER				X	
SFC. RADIOMETER			X		
FORMVAR				X	
PHOTOGRAPHY	FWD			X	
	LS	X			
	RS	X			
	DWN			X	
AXBT	TUBES			X	
	RECEIVERS			X	
ODW				X	

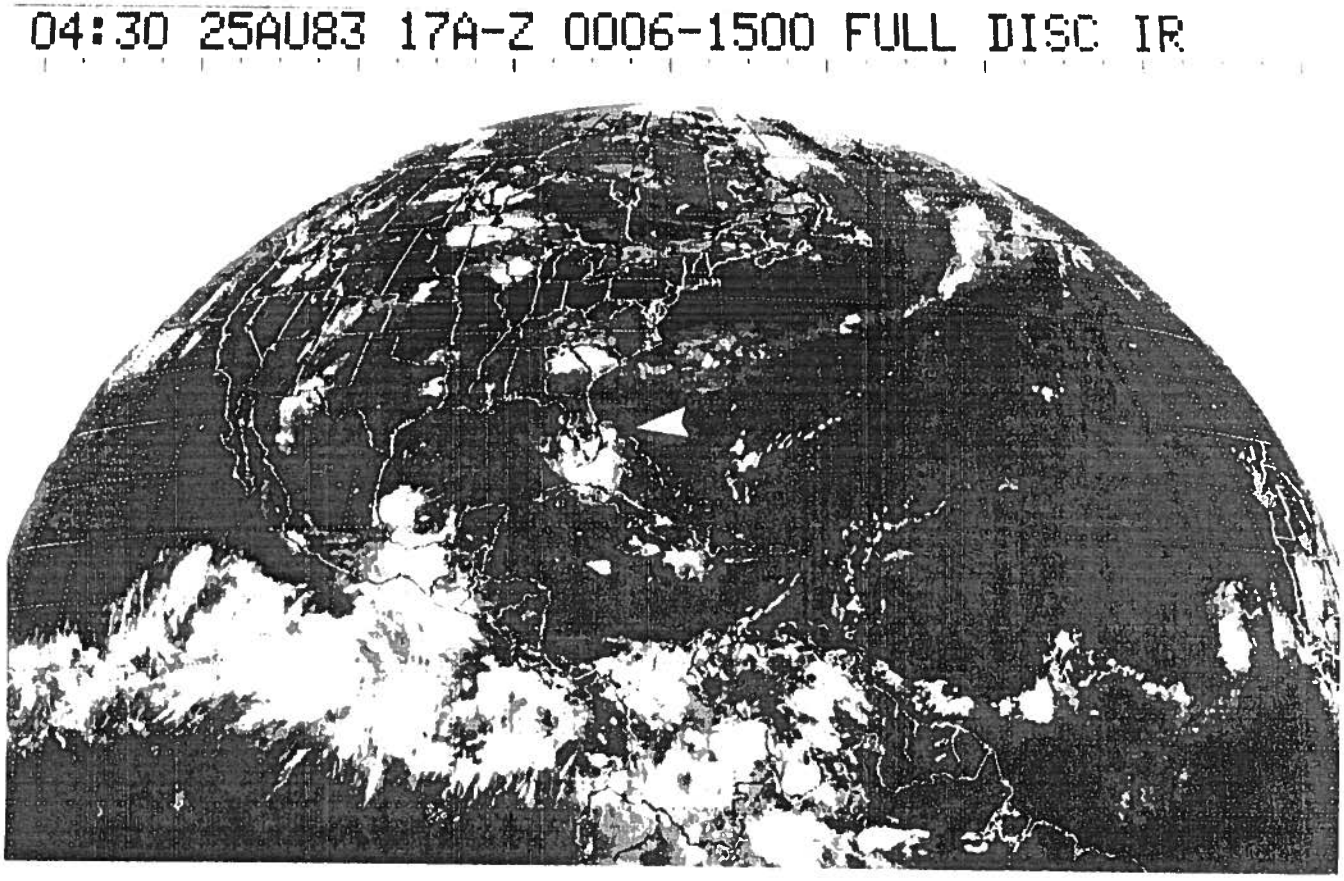

Fig. 37. BARRY (25 August 1983/0430 GMT) GOES-EAST/FULL DISC IR.

FLIGHT LOG

Date:	August 25, 1983
Flight Identification:	830825H
Aircraft:	WP-3D/N42RF
Departed:	Miami, Florida, at 25/0143 GMT
Arrived:	Miami, Florida, at 25/0715 GMT
Purpose:	Reconnaissance (NHC)/research (HRD) - T. S. BARRY.
Pattern:	See Fig. 4/Vortex Evolution (pattern I) option 1 (modified); altitude 5 K ft. Single-aircraft mission with six passes in or near storm center. Pattern modified due to poor eye definition and investigation of convective bands southwest of center.

FILM LOG

Camera	Roll	From [Day/Time (GMT)]	To [Day/Time (GMT)]

NO FILM TAKEN

TAPE LOG: 830825H

Tape Type	Number	From [Day/Time (GMT)]	To [Day/Time (GMT)]
RFC Standard	1/1	25/0150	25/0710
Radar	1/4	25/0239	25/0359
Radar	2/4	25/0359	25/0502
Radar	3/4	25/0502	25/0604
Radar	4/4	25/0604	25/0643
Knollenberg	1/6	25/0225	25/0316
Knollenberg	2/6	25/0316	25/0447
Knollenberg	3/6	25/0447	25/0558
Knollenberg	4/6	25/0558	25/0626
Knollenberg	5/6	25/0626	25/0641
Knollenberg	6/6	25/0641	25/0701
Slow	1/1	25/0150	25/0710

EQUIPMENT STATUS: 830825H

SYSTEM	STATUS /	UP	DOWN	NOT USED	REMARKS
NAV	INE 1	X			0332 GMT free-running
	INE 2	X			
	ONE	X			0332 GMT INE #1 discon.
	DOPL	X			
RADAR	NOSE			X	
	LF	X			
	TAIL	X			0254 GMT tail radar brks.
	DOPPLER			X	
	DATA SYSTEM	X			Mem. Disc #2 problems
RAMS	DATA SYSTEM	X			Ramtek Ch 0 problem
	TOTAL TEMP. 1	X			
	TOTAL TEMP. 2	X			
	DEW POINT	X			
	ATTACK ANGLE	X			
	SLIP ANGLE	X			
	ABS. PRESS.	X			
	DIFF. PRESS.	X			
	RADAR ALT.	X			
	J & W	X			
PMS	OAP 2DP	X			
	OAP 2DC	X			Clear-air updt., disct.
	FSSP 100	X			
	DATA SYSTEM	X			Bad Mem A-slice display
IPC				X	
FOIL				X	
CO_2 RADIOMETER			X		
MICRO. RADIOMETER				X	
SFC. RADIOMETER			X		
FORMVAR				X	
PHOTOGRAPHY	FWD			X	
	LS			X	
	RS			X	
	DWN			X	
AXBT	TUBES			X	
	RECEIVERS			X	
ODW				X	

STORM NAME	DATE(S) FLOWN	MISSION(S) IDENT.	TYPE[10]	REMARKS	FIGURES
DEAN	28 Sept 1983	830928I	ASI/R	Atlantic	29,38
	29 Sept 1983	830929H1	LTM/R		29,39
	29 Sept 1983	830929I	LTM/R		29,40

Tropical Storm DEAN (27-30 September 1983): Dean formed in an area between the Bahamas and Bermuda on 27 September. The storm traveled northward, but made a turn toward the eastern shore of Virginia on 29 September. On 30 September Tropical Storm Dean moved onshore near the Maryland-Virginia border and dissipated in the Potomac River area within a few hours. Storm-associated damage was generally limited to minor beach erosion and flooding along portions of the mid-Atlantic coast. [National Climatic Center, 1983b; Gerrish and Case, 1984.]

10. ASI: Air-sea interaction. A reconnaissance storm penetration was also accomplished in support of NHC.

R: Reconnaissance (NHC) and research (HRD) mission objectives.

LTM: Long-term monitoring experiment.

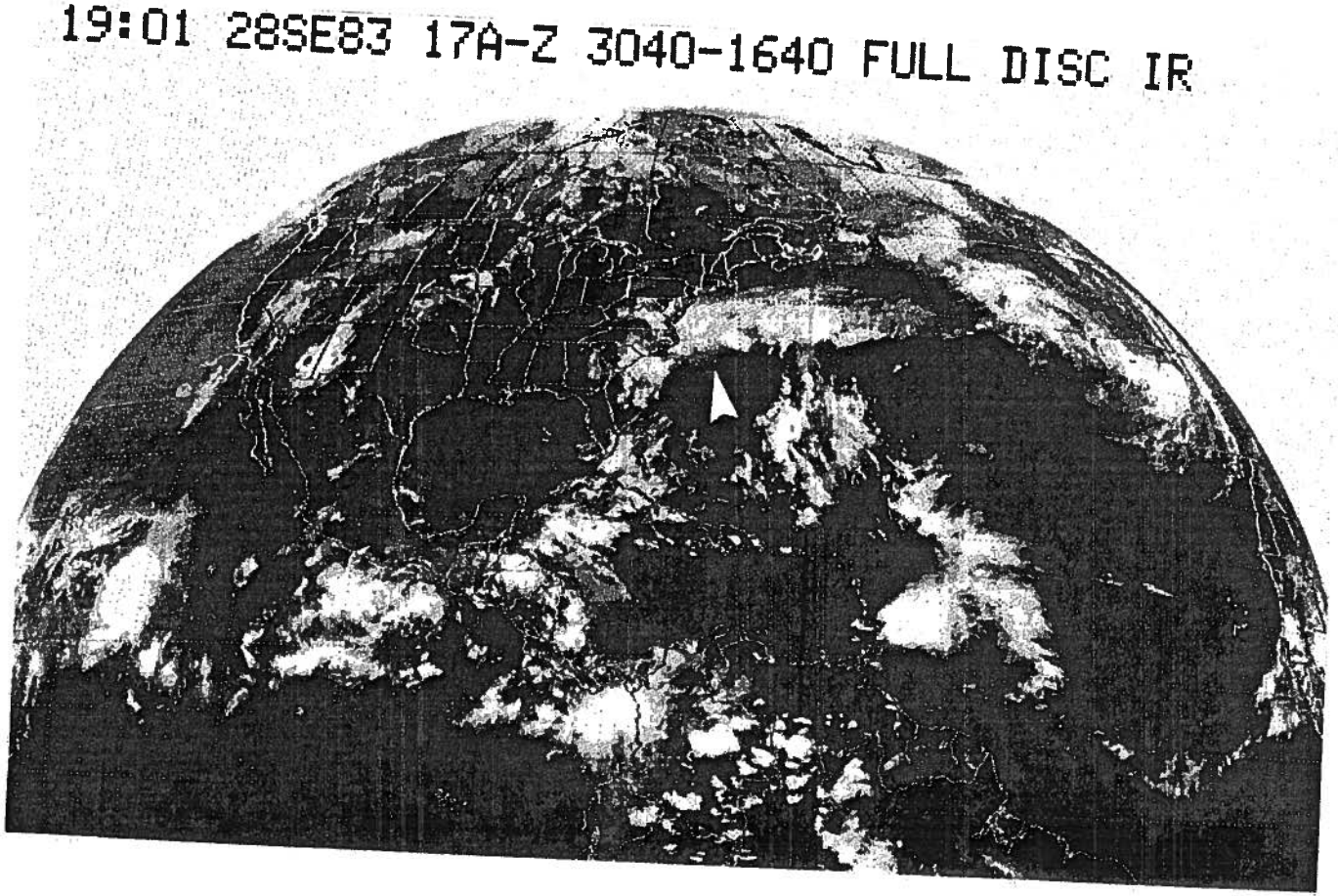

Fig. 38. DEAN (28 September 1983/1901 GMT) GOES-EAST/FULL DISC IR.

FLIGHT LOG

Date:	September 28, 1983
Flight Identification:	830928I
Aircraft:	WP-3D/N43RF
Departed:	Miami, Florida, at 28/1320 GMT
Arrived:	Miami, Florida, at 28/2220 GMT
Purpose:	(a) Air-Sea Interaction over/vicinity of Gulf Stream; (b) T. S. DEAN penetration.
Pattern:	None specified; PI option; fly NE to 34.0°N 70.0°W and return. Altitudes 0.3, 1.0 and 5.0 K ft. Single-aircraft mission for Gulf current study using AXBT and SLAR followed by a 5 K ft pass through T. S. DEAN at 28/1905 GMT.

FILM LOG

Camera	Roll	From [Day/Time (GMT)]	To [Day/Time (GMT)]
Left-side	1/1	28/1320	28/2220
Right-side	1/1	28/1320	28/2220
Down		130 frames of 60 mm film	

AXBT LOG: 830928I

AXBT/Number	Drop [Day/Time (GMT)]	Comments
1	28/154200	
2	28/155122	
3	28/161648	
4	28/164253	
5	28/165200	
6	28/171005	
7	28/172442	
8	28/181252	
9	28/191536	
10	28/195050	

TAPE LOG: 830928I

Tape Type	Number	From [Day/Time (GMT)]	To [Day/Time GMT]
RFC Standard	1/1	28/1320	28/2219
Slow	1/1	28/1320	28/2219

EQUIPMENT STATUS: 830928I

SYSTEM	STATUS /	UP	DOWN	NOT USED	REMARKS
NAV	INE 1	X			1735 GMT free-running
	INE 2	X			
	ONE	X			1735 GMT INE#1 discon.
	DOPL	X			
RADAR	NOSE	X			
	LF			X	
	TAIL	X			
	DOPPLER	X			
	DATA SYSTEM			X	
RAMS	DATA SYSTEM	X			1510, 1547 GMT CPU#1 brk.
	TOTAL TEMP. 1	X			
	TOTAL TEMP. 2	X			
	DEW POINT	X			
	ATTACK ANGLE	X			
	SLIP ANGLE	X			
	ABS. PRESS.	X			
	DIFF. PRESS.	X			
	RADAR ALT.	X			
	J & W	X			
PMS	OAP 2DP			X	
	OAP 2DC			X	
	FSSP 100			X	
	DATA SYSTEM			X	
IPC				X	
FOIL				X	
CO_2 RADIOMETER				X	
MICRO. RADIOMETER				X	
SFC. RADIOMETER		X			
FORMVAR				X	
PHOTOGRAPHY	FWD			X	
	LS	X			
	RS	X			
	DWN	X			130 frms, times bad
AXBT	TUBES	X			10 launches
	RECEIVERS	X			Temporary audio discon.
ODW				X	

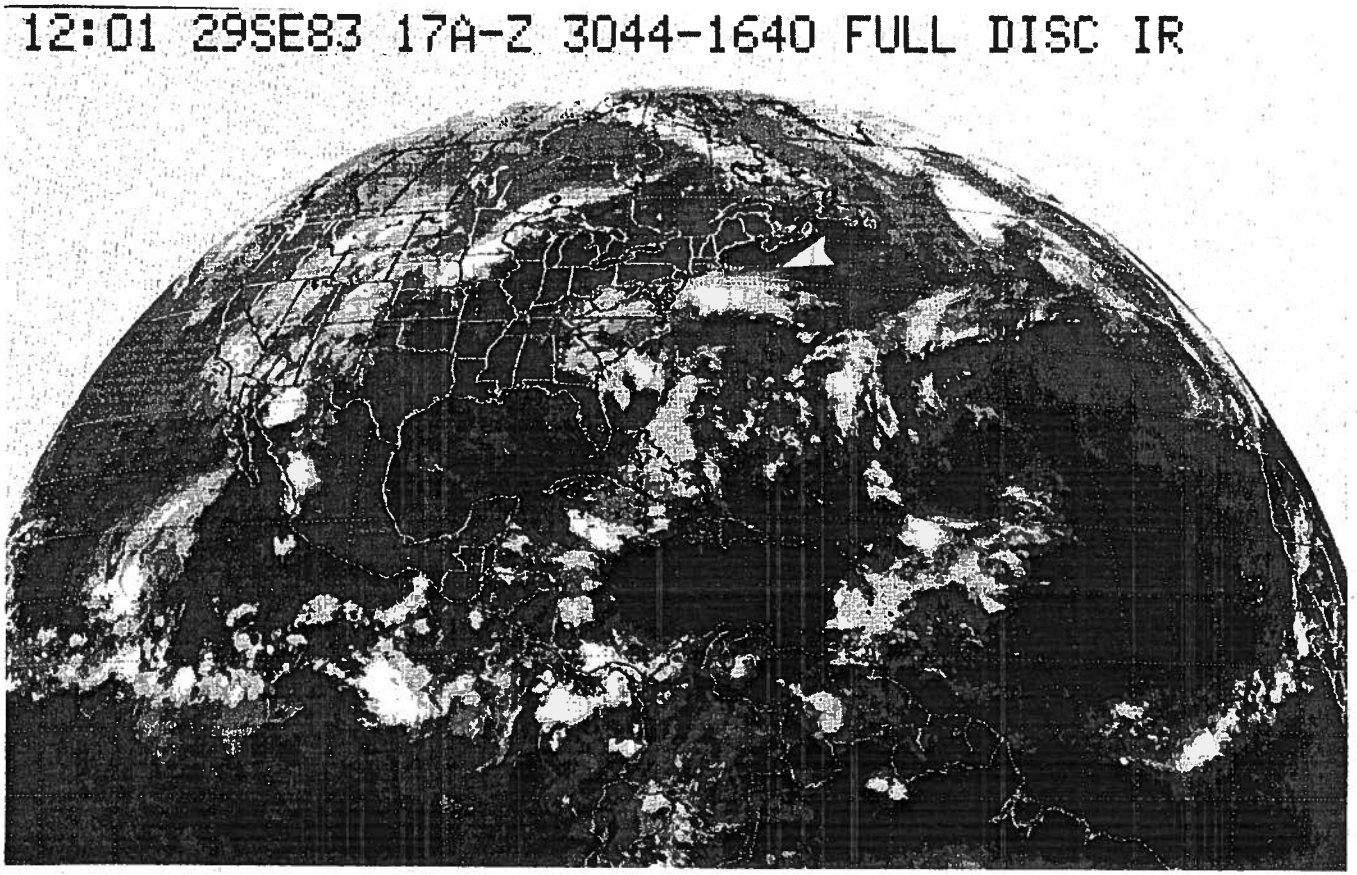

Fig. 39. DEAN (29 September 1983/1201 GMT) GOES-EAST/FULL DISC IR.

FLIGHT LOG

Date:	September 29, 1983
Flight Identification:	830929H1
Aircraft:	WP-3D/N42RF
Departed:	Miami, Florida, at 29/0630 GMT
Arrived:	Miami, Florida, at 29/1704 GMT
Purpose:	Reconnaissance (NHC)/research (HRD) - T. S. DEAN.
Pattern:	See Fig. 5/pattern III (modified); altitude 1.5 K ft. Single-aircraft mission with four passes. Pattern modified due to poorly defined center.

FILM LOG

Camera	Roll	From [Day/Time (GMT)]	To [Day/Time (GMT)]
Forward	1/1	29/0630	29/1704
Left-side	1/1	29/0630	29/1704
Right-side	1/1	29/0630	29/1704

TAPE LOG: 830929H1

Tape Type	Number	From [Day/Time (GMT)]	To [Day/Time (GMT)]
RFC Standard	1/1	29/0630	29/1704
Radar	1/5	29/0914	29/1026
Radar	2/5	29/1026	29/1144
Radar	3/5	29/1144	29/1248
Radar	4/5	29/1248	29/1343
Radar	5/5	29/1344	29/1452
Knollenberg	1/7	29/0900	29/1005
Knollenberg	2/7	29/1005	29/1112
Knollenberg	3/7	29/1153	29/1221
Knollenberg	4/7	29/1221	29/1242
Knollenberg	5/7	29/1242	29/1254
Knollenberg	6/7	29/1254	29/1307
Knollenberg	7/7	29/1307	29/1357
Slow	1/1	29/0630	29/1704

EQUIPMENT STATUS: 830929H1

SYSTEM	STATUS /	UP	DOWN	NOT USED	REMARKS
NAV	INE 1	X			
	INE 2	X			
	ONE	X			
	DOPL	X			
RADAR	NOSE			X	
	LF	X			
	TAIL	X			
	DOPPLER			X	
	DATA SYSTEM	X			DSC#2 several time-outs
RAMS	DATA SYSTEM	X			1215 GMT CPU#1 break
	TOTAL TEMP. 1	X			
	TOTAL TEMP. 2	X			
	DEW POINT	X			
	ATTACK ANGLE	X			
	SLIP ANGLE	X			
	ABS. PRESS.	X			
	DIFF. PRESS.	X			
	RADAR ALT.	X			
	J & W	X			
PMS	OAP 2DP	X			0930 GMT elem. 1 & 18 intrm.
	OAP 2DC	X			0930 GMT cont. update
	FSSP 100	X			
	DATA SYSTEM	X			
IPC				X	
FOIL				X	
CO_2 RADIOMETER		X			
MICRO. RADIOMETER				X	
SFC. RADIOMETER		X			
FORMVAR				X	
PHOTOGRAPHY	FWD	X			
	LS	X			
	RS	X			
	DWN			X	
AXBT	TUBES			X	
	RECEIVERS			X	
ODW				X	

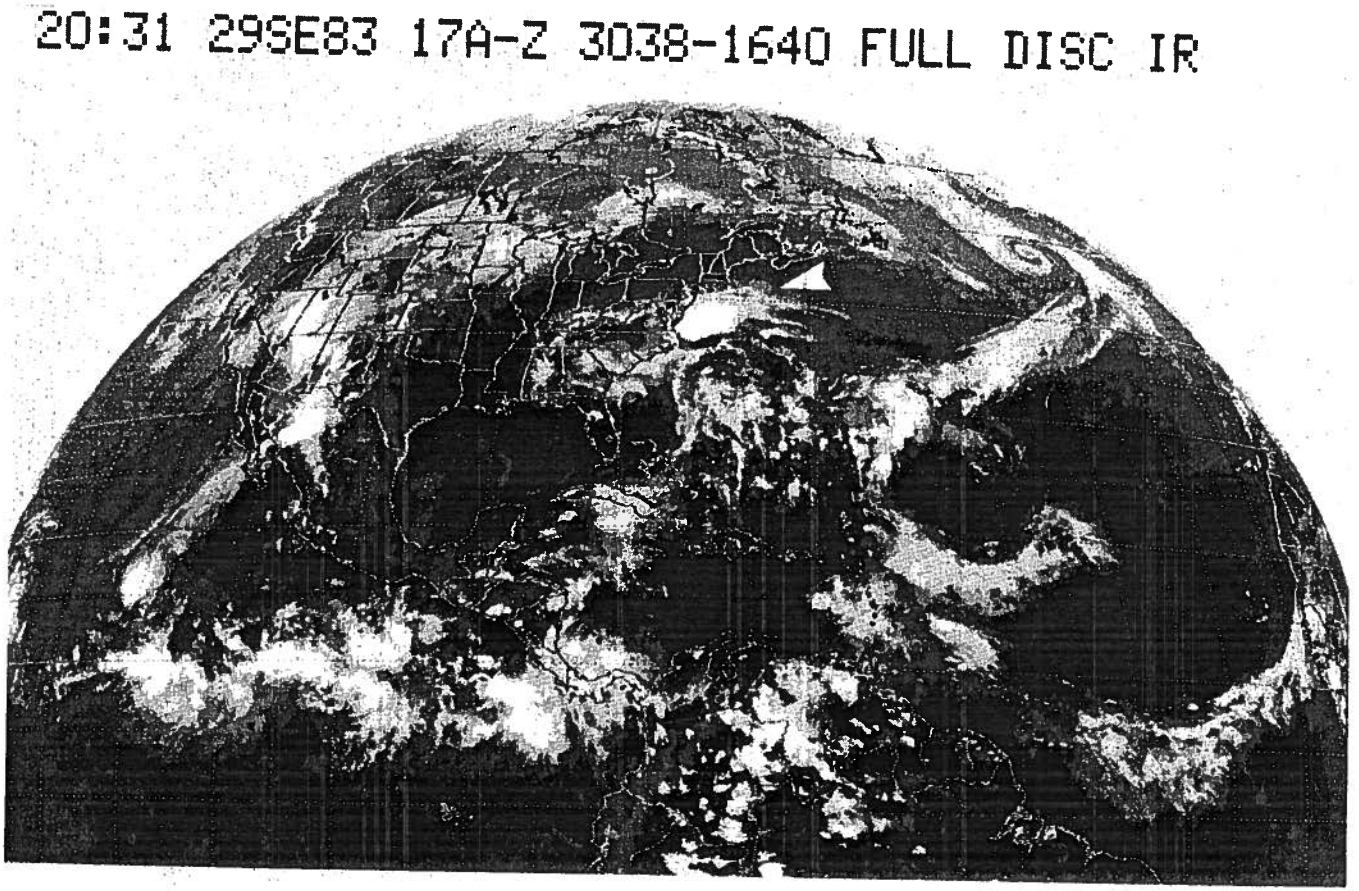

Fig. 40. DEAN (29 September 1983/2031 GMT) GOES-EAST/FULL DISC IR.

FLIGHT LOG

Date:	September 29, 1983
Flight Identification:	830929I
Aircraft:	WP-3D/N43RF
Departed:	Miami, Florida, at 29/1450 GMT
Arrived:	Miami, Florida, at 30/0205 GMT
Purpose:	Reconnaissance (NHC)/research (HRD) - T. S. DEAN.
Pattern:	See Fig. 5 (modified); altitude 1.5 K ft. Single-aircraft mission. Standard RFC storm penetration modified due to storm asymmetry.

FILM LOG

Camera	Roll	From [Day/Time (GMT)]	To [Day/Time (GMT)]
Forward	1/1	29/1450	30/0205

TAPE LOG: 830929I

Tape Type	Number	From [Day/Time (GMT)]	To [Day/Time (GMT)]
RFC Standard	1/1	29/1503	30/0203
Slow	1/1	29/1503	30/0203

EQUIPMENT STATUS: 830929I

SYSTEM	STATUS /	UP	DOWN	NOT USED	REMARKS
NAV	INE 1	X			2300 GMT discon. free-run
	INE 2	X			
	ONE	X			
	DOPL	X			
RADAR	NOSE			X	
	LF			X	
	TAIL			X	
	DOPPLER			X	
	DATA SYSTEM			X	
RAMS	DATA SYSTEM	X			1821, 2009, 2200, 0058 GMT halts
	TOTAL TEMP. 1	X			
	TOTAL TEMP. 2	X			
	DEW POINT	X			
	ATTACK ANGLE	X			
	SLIP ANGLE	X			
	ABS. PRESS.	X			
	DIFF. PRESS.	X			
	RADAR ALT.	X			
	J & W	X			
PMS	OAP 2DP			X	
	OAP 2DC			X	
	FSSP 100			X	
	DATA SYSTEM			X	
IPC				X	
FOIL				X	
CO_2 RADIOMETER				X	
MICRO. RADIOMETER				X	
SFC. RADIOMETER			X		
FORMVAR				X	
PHOTOGRAPHY	FWD	X			Lens fogged/film bad
	LS			X	
	RS			X	
	DWN			X	
AXBT	TUBES			X	
	RECEIVERS			X	
ODW				X	

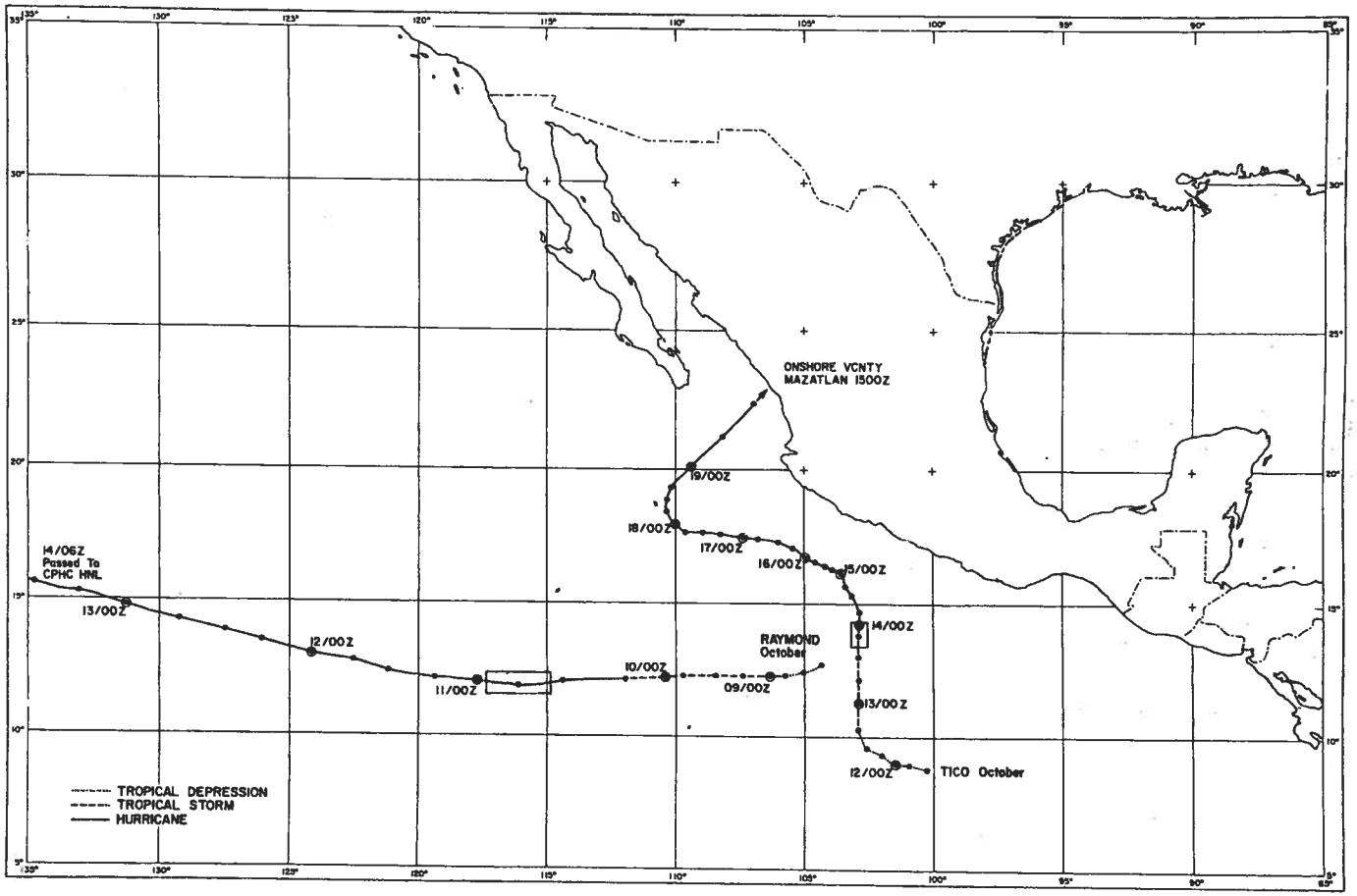

Fig. 41. Best-track plots for Eastern Pacific storms investigated by HRD during the 1983 hurricane season.

STORM NAME	DATE(S) FLOWN	MISSION(S) IDENT.	TYPE[11]	REMARKS	FIGURES
RAYMOND	10 Oct 1983	831010I	CDYN/RB	E. Pacific	41,42
	10 Oct 1983	831010H	CDYN/RB/WB		41,43

Hurricane RAYMOND (8-14 October 1983): The tropical wave that eventually became Hurricane Raymond passed into the Pacific from Nicaragua on 5 October and moved westward at about 15 kt (8 m s^{-1}). By 0600 GMT/8 October EPHC issued its first bulletin for tropical depression 19. At that time, the depression, accompanied by winds to 30 kt (16 m s^{-1}), was near 12.4°N. 104.4°W. The depression continued to move due west at 5 kt (2 m s^{-1}) over very warm water (29° to 30°C). By 0000 GMT/9 October the system intensified to tropical storm strength near 12.3°N. 106.4°W. Raymond continued moving westward, accelerated, and intensified. By 1200 GMT/10 October, Raymond was upgraded to a hurricane near 12.0°N. 114.6°W., with 65 kt (33 m s^{-1}) winds. It continued to move west at 15 kt (8 m s^{-1}). Raymond intensified rapidly and attained winds of 125 kt (64 m s^{-1}) by 1200 GMT/11 October. Turning west-northwest and moving at 16 to 18 kt (8 to 9 m s^{-1}) over water with temperatures above 27°C, Raymond remained a small, but powerful, hurricane as it passed 140°W. At 0600 GMT/14 October the EPHC issued its final bulletin on Raymond. [R. Cross, 1984: Personal communication.]

11. CDYN: Cloud dynamics experiment.
RB: Rainband experiment option.
WB: Water budget study option.

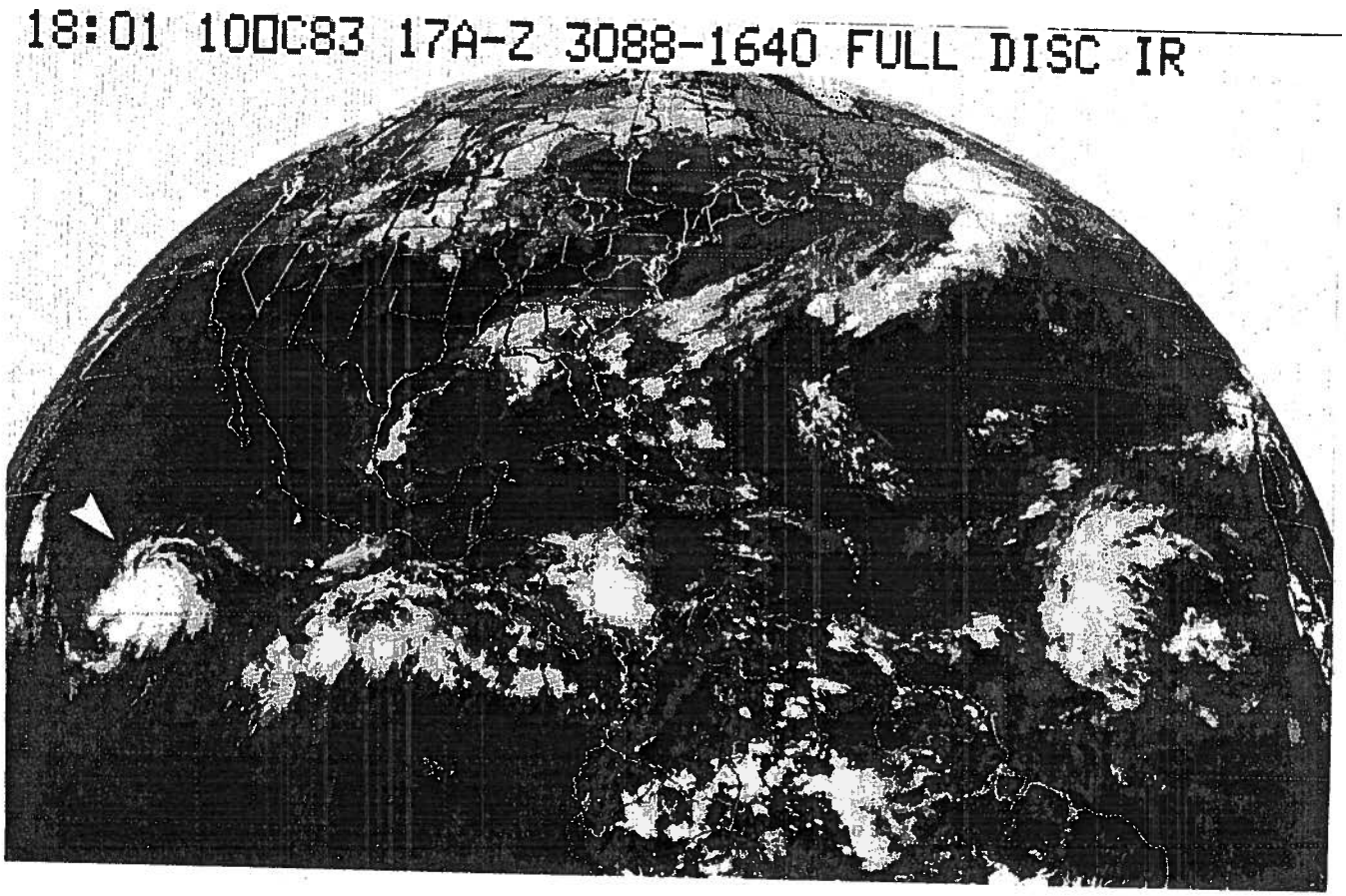

Fig. 42. RAYMOND (10 October 1983/1801 GMT) GOES-WEST/FULL DISC IR.

FLIGHT LOG

Date:	October 10, 1983
Flight Identification:	831010I
Aircraft:	WP-3D/N43RF
Departed:	Guadalajara, Mexico, at 10/1339 GMT
Arrived:	Guadalajara, Mexico, at 10/2224 GMT
Purpose:	Rainband experiment - T. S. RAYMOND (E. Pacific).
Pattern:	See Fig. 5/pattern III, option 1 (modified); altitude 5.0 K ft. Two-aircraft daylight mission, with N43RF making a single pass. Pattern modified due to limited time available on station.

FILM LOG

Camera	Roll	From [Day/Time (GMT)]	To [Day/Time (GMT)]
Forward	1/1	10/1339	10/2224
Left-side	1/1	10/1339	10/2224
Right-side	1/1	10/1339	10/2224

TAPE LOG: 831010I

Tape Type	Number	From [Day/Time (GMT)]	To [Day/Time (GMT)]
RFC Standard	1/1	10/1339	10/2224
Radar	1/7	10/1635	10/1648
Radar	2/7	10/1648	10/1707
Radar	3/7	10/1707	10/1732
Radar	4/7	10/1732	10/1756
Radar	5/7	10/1756	10/1819
Radar	6/7	10/1819	10/1838
Radar	7/7	10/1838	10/1908
Knollenberg	1/6	10/1633	10/1656
Knollenberg	2/6	10/1656	10/1715
Knollenberg	3/6	10/1715	10/1730
Knollenberg	4/6	10/1730	10/1751
Knollenberg	5/6	10/1751	10/1835
Knollenberg	6/6	10/1835	10/1900
Slow	1/1	10/1339	10/2225
Doppler	1/5	10/1649	10/1707
Doppler	2/5	10/1712	10/1730
Doppler	3/5	10/1734	10/1753
Doppler	4/5	10/1757	10/1819
Doppler	5/5	10/1822	10/1855

EQUIPMENT STATUS: 831010I

SYSTEM	STATUS /	UP	DOWN	NOT USED	REMARKS
NAV	INE 1	X			
	INE 2	X			
	ONE	X			
	DOPL	X			
RADAR	NOSE			X	
	LF	X			
	TAIL	X			
	DOPPLER	X			
	DATA SYSTEM	X			
RAMS	DATA SYSTEM	X			1530 GMT CPU#1 break
	TOTAL TEMP. 1	X			
	TOTAL TEMP. 2	X			
	DEW POINT	X			
	ATTACK ANGLE	X			
	SLIP ANGLE	X			
	ABS. PRESS.	X			
	DIFF. PRESS.	X			
	RADAR ALT.	X			
	J & W	X			
PMS	OAP 2DP	X			
	OAP 2DC	X			
	FSSP 100	X			
	DATA SYSTEM	X			
IPC				X	
FOIL				X	
CO_2 RADIOMETER				X	
MICRO. RADIOMETER				X	
SFC. RADIOMETER		X			
FORMVAR				X	
PHOTOGRAPHY	FWD	X			Lens fogged/film bad
	LS	X			
	RS	X			
	DWN			X	
AXBT	TUBES			X	
	RECEIVERS			X	
ODW				X	

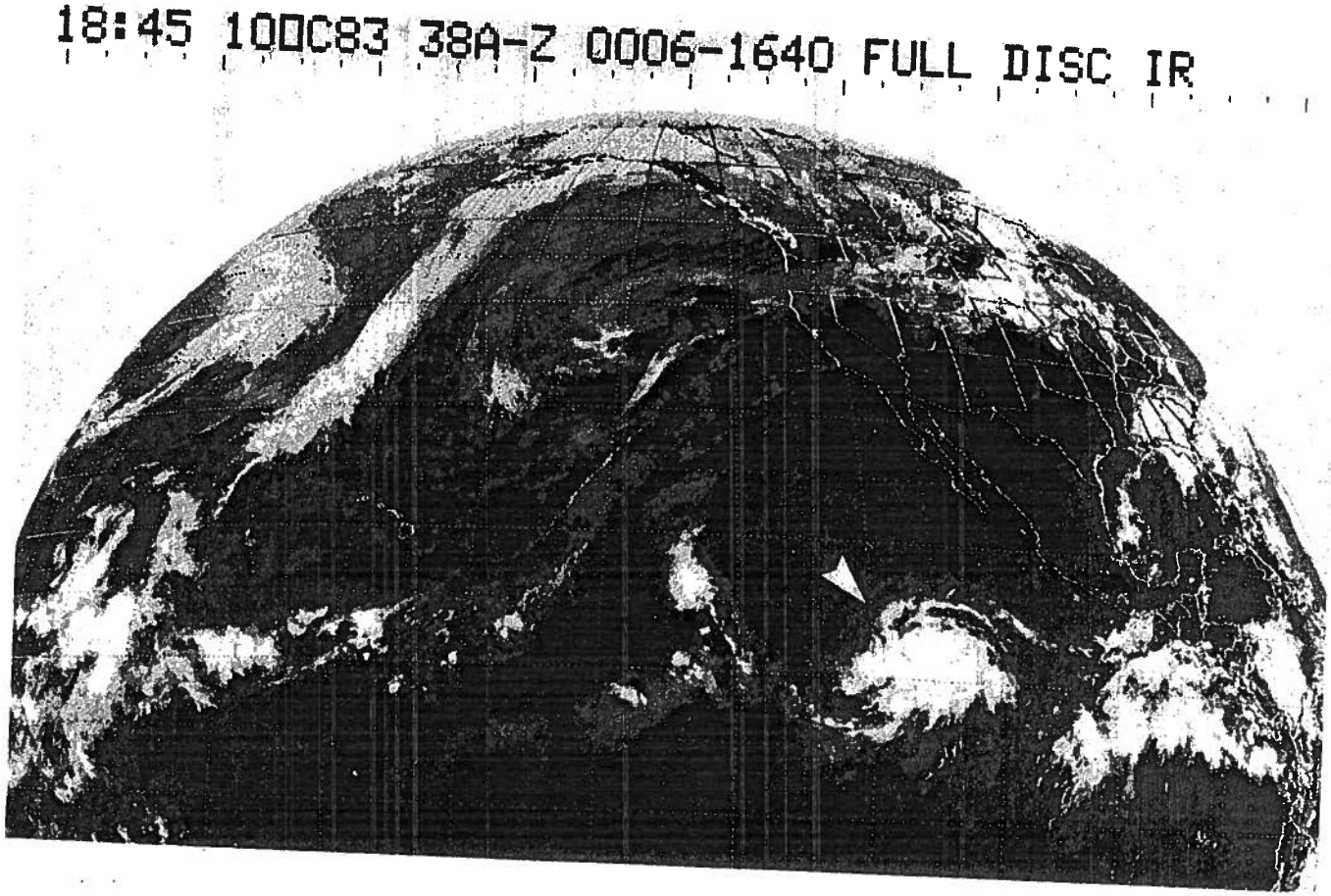

Fig. 43. RAYMOND (10 October 1983/1845 GMT) GOES-WEST/FULL DISC IR.

FLIGHT LOG

Date:	October 10, 1983
Flight Identification:	831010H
Aircraft:	WP-3D/N42RF
Departed:	Guadalajara, Mexico, at 10/1331 GMT
Arrived:	Guadalajara, Mexico, at 10/2307 GMT
Purpose:	Rainband experiment - T. S. RAYMOND (E. Pacific).
Pattern:	See Fig. 5/pattern III, option 1 (modified); altitudes 0.3, 1.0, and 2.0 K ft. Two-aircraft daylight mission, with N42RF making three passes. Pattern modified due to limited time available on station.

FILM LOG

Camera	Roll	From [Day/Time (GMT)]	To [Day/Time (GMT)]
Forward	1/1	10/1331	10/2307
Left-side	1/1	10/1331	10/2307
Right-side	1/1	10/1331	10/2307

TAPE LOG: 831010H

Tape Type	Number	From [Day/Time (GMT)]	To [Day/Time (GMT)]
RFC Standard	1/1	10/1331	10/2039
Radar	1/7	10/1619	10/1651
Radar	2/7	10/1651	10/1722
Radar	3/7	10/1731	10/1748
Radar	4/7	10/1748	10/1824
Radar	5/7	10/1826	10/1854
Radar	6/7	10/1854	10/1925
Radar	7/7	10/1925	10/1955
Knollenberg	1/6	10/1618	10/1646
Knollenberg	2/6	10/1646	10/1716
Knollenberg	3/6	10/1716	10/1751
Knollenberg	4/6	10/1751	10/1913
Knollenberg	5/6	10/1913	10/1929
Knollenberg	6/6	10/1929	10/2000
Slow	1/1	10/1331	10/2039

EQUIPMENT STATUS: 831010H

SYSTEM	STATUS /	UP	DOWN	NOT USED	REMARKS
NAV	INE 1	X			
	INE 2	X			
	ONE	X			
	DOPL	X			
RADAR	NOSE			X	
	LF	X			
	TAIL	X			
	DOPPLER			X	
	DATA SYSTEM	X			1448 GMT DSC#2 problem
RAMS	DATA SYSTEM	X			1600, 1615 GMT Rmtk. brk.
	TOTAL TEMP. 1	X			
	TOTAL TEMP. 2	X			
	DEW POINT	X			
	ATTACK ANGLE	X			
	SLIP ANGLE	X			
	ABS. PRESS.	X			
	DIFF. PRESS.	X			
	RADAR ALT.	X			
	J & W	X			
PMS	OAP 2DP	X			Update problem
	OAP 2DC	X			1619 GMT clear-air update
	FSSP 100	X			
	DATA SYSTEM	X			
IPC				X	
FOIL				X	
CO_2 RADIOMETER		X			
MICRO. RADIOMETER				X	
SFC. RADIOMETER		X			
FORMVAR				X	
PHOTOGRAPHY	FWD	X			
	LS	X			
	RS	X			
	DWN			X	
AXBT	TUBES			X	
	RECEIVERS			X	
ODW				X	

STORM NAME	DATE(S) FLOWN	MISSION(S) IDENT.	TYPE[12]	REMARKS	FIGURES
TICO	13 Oct 1983	831013I	CDYN/RB/WB	E. Pacific	41,44
	13 Oct 1983	831013H	CDYN/RB/WB		41,45

Hurricane TICO (11-19 October 1983): Tico began as a tropical depression 500 nmi (925 km) south of Acapulco, Mexico, on 11 October. Moving west-northwest, the system intensified slowly and was upgraded to a tropical storm 36 h later. The storm turned north and, after another 36 h, reached hurricane strength about 215 nmi (398 km) west-southwest of Acapulco. Tico then turned west until it was south of the Baja California peninsula. The hurricane began to recurve to the northeast, passing over Mazatlan, Mexico, on 19 October. Twenty-five thousand people were left homeless in the vicinity of Mazatlan after Tico's passage, eight people were reported missing, and property damage was estimated at $66 million. [Gunther, 1984.]

12. CDYN: Convective dynamics experiment.
RB: Rainband experiment option.
WB: Water budget study option.

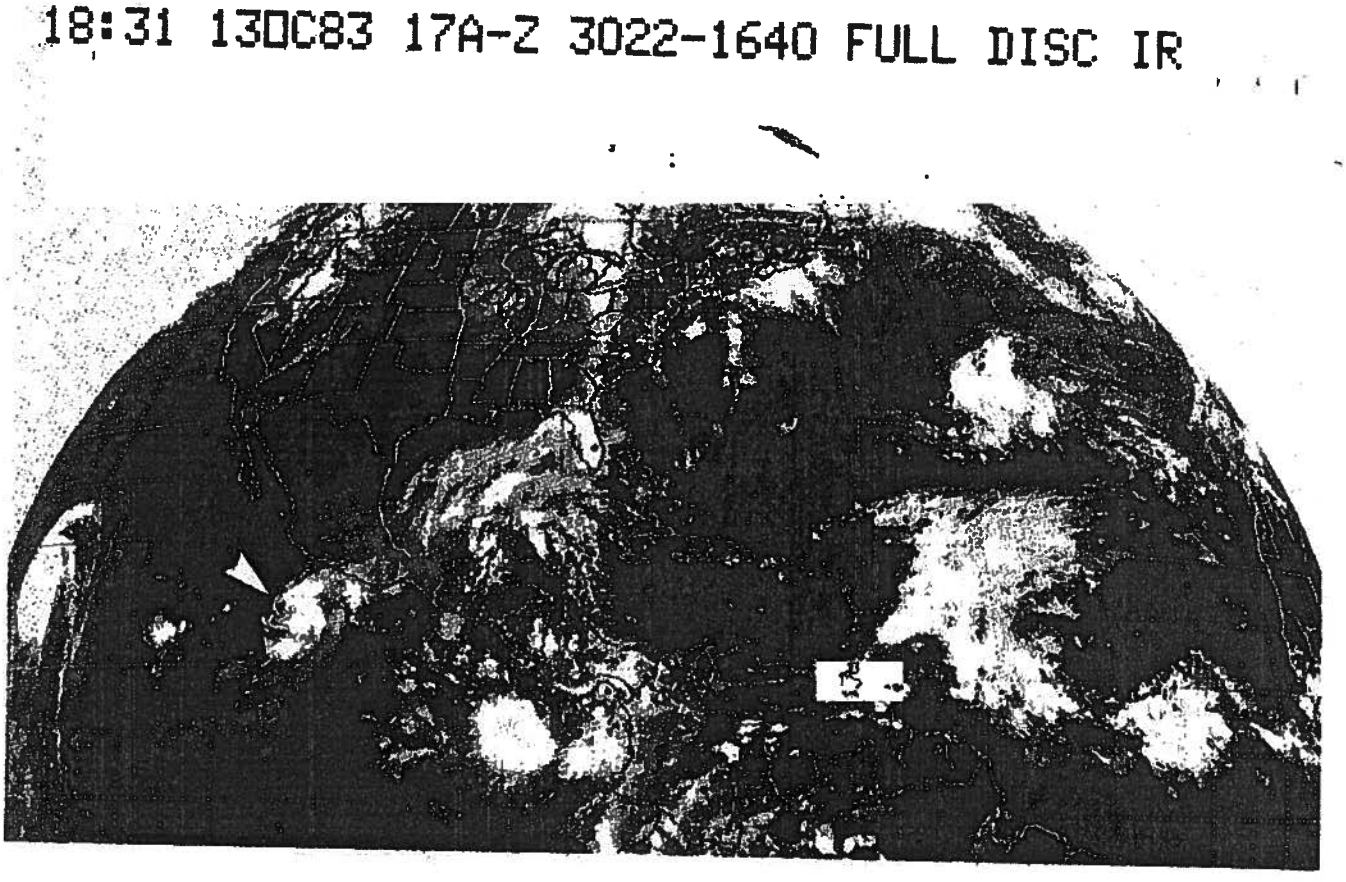

Fig. 44. TICO 13 October 1983/1831 GMT GOES-WEST/FULL DISC IR.

FLIGHT LOG

Date:	October 13, 1983
Flight Identification:	831013I
Aircraft:	WP-3D/N43RF
Departed:	Acapulco, Mexico, at 13/1504 GMT
Arrived:	Acapulco, Mexico, at 13/2216 GMT
Purpose:	Rainband and water budget experiment - T. S. TICO (E. Pacific).
Pattern:	See Fig. 5/pattern III, option 1 (modified); altitude 5 K ft. Two-aircraft mission, with N43RF making seven passes. At 2030 GMT switched to water budget phase. Mission aborted due to #2 engine malfunction.

FILM LOG

Camera	Roll	From [Day/Time (GMT)]	To [Day/Time (GMT)]
Forward	1/1	13/1504	13/2216
Left-side	1/1	13/1504	13/2216
Right-side	1/1	13/1504	13/2216

TAPE LOG: 831013I

Tape Type	Number	From [Day/Time (GMT)]	To [Day/Time (GMT)]
RFC Standard	1/01	13/1504	13/2217
Radar	1/13	13/1556	13/1622
Radar	2/13	13/1622	13/1650
Radar	3/13	13/1650	13/1717
Radar	4/13	13/1717	13/1802
Radar	5/13	13/1802	13/1825
Radar	6/13	13/1825	13/1848
Radar	7/13	13/1848	13/1910
Radar	8/13	13/1910	13/1931
Radar	9/13	13/1931	13/1957
Radar	10/13	13/1957	13/2025
Radar	11/13	13/2025	13/2048
Radar	12/13	13/2048	13/2141
Radar	13/13	13/2141	13/2200
Knollenberg	1/22	13/1614	13/1624
Knollenberg	2/22	13/1626	13/1706
Knollenberg	3/22	13/1706	13/1725
Knollenberg	4/22	13/1725	13/1734
Knollenberg	5/22	13/1734	13/1809
Knollenberg	6/22	13/1809	13/1820
Knollenberg	7/22	13/1820	13/1830
Knollenberg	8/22	13/1830	13/1837
Knollenberg	9/22	13/1837	13/1841
Knollenberg	10/22	13/1841	13/1847
Knollenberg	11/22	13/1847	13/1852
Knollenberg	12/22	13/1852	13/1903
Knollenberg	13/22	13/1911	13/1918
Knollenberg	14/22	13/1918	13/1923
Knollenberg	15/22	13/1923	13/1928
Knollenberg	16/22	13/1928	13/1935
Knollenberg	17/22	13/1935	13/1942
Knollenberg	18/22	13/1942	13/2009
Knollenberg	19/22	13/2023	13/2032
Knollenberg	20/22	13/2032	13/2041
Knollenberg	21/22	13/2041	13/2100
Knollenberg	22/22	13/2100	13/2136
Slow	1/01	13/1504	13/2217

TAPE LOG: 831013I

Tape Type	Number	From [Day/Time (GMT)]	To [Day/Time (GMT)]
Doppler	1/11	13/1607	13/1622
Doppler	2/11	13/1625	13/1724
Doppler	3/11	13/1754	13/1815
Doppler	4/11	13/1824	13/1845
Doppler	5/11	13/1853	13/1908
Doppler	6/11	13/1912	13/1926
Doppler	7/11	13/1929	13/1949
Doppler	8/11	13/2003	13/2022
Doppler	9/11	13/2025	13/2046
Doppler	10/11	13/2049	13/2106
Doppler	11/11	13/2123	13/2135

EQUIPMENT STATUS: 831013I

SYSTEM	STATUS /	UP	DOWN	NOT USED	REMARKS
NAV	INE 1	X			
	INE 2	X			
	ONE	X			
	DOPL	X			
RADAR	NOSE			X	
	LF	X			
	TAIL	X			
	DOPPLER	X			
	DATA SYSTEM	X			
RAMS	DATA SYSTEM	X			1746 GMT halt/1820 GMT stop
	TOTAL TEMP. 1	X			
	TOTAL TEMP. 2	X			
	DEW POINT	X			
	ATTACK ANGLE	X			
	SLIP ANGLE	X			
	ABS. PRESS.	X			
	DIFF. PRESS.	X			
	RADAR ALT.	X			
	J & W	X			
PMS	OAP 2DP	X			1847 GMT shut down
	OAP 2DC	X			
	FSSP 100	X			
	DATA SYSTEM	X			
IPC				X	
FOIL				X	
CO_2 RADIOMETER				X	
MICRO. RADIOMETER				X	
SFC. RADIOMETER		X			
FORMVAR				X	
PHOTOGRAPHY	FWD	X			Water in camera
	LS	X			
	RS	X			
	DWN			X	
AXBT	TUBES			X	
	RECEIVERS			X	
ODW				X	

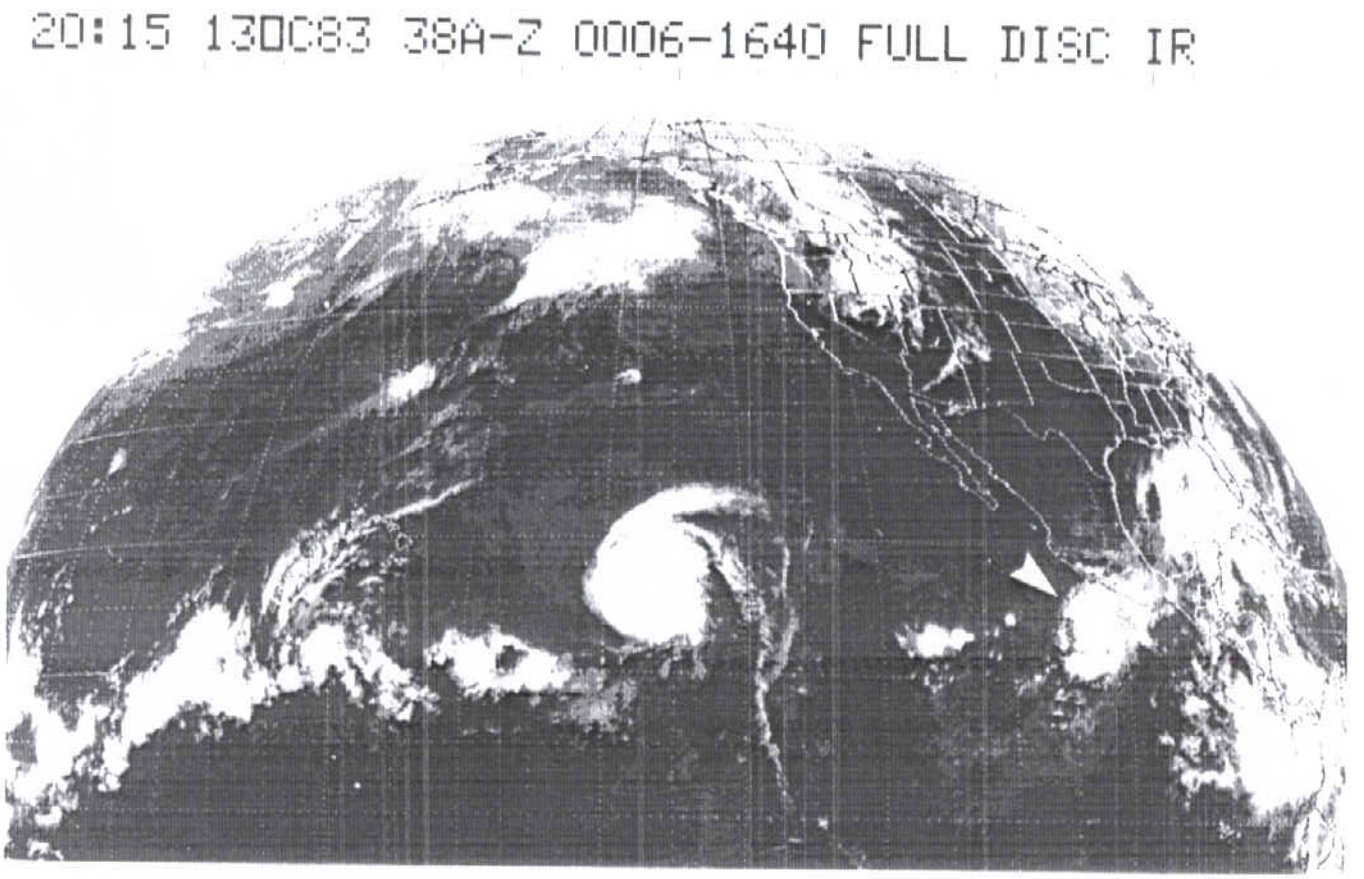

Fig. 45. TICO (13 October 1983/2015 GMT) GOES-WEST/FULL DISC IR.

FLIGHT LOG

Date:	October 13, 1983
Flight Identification:	831013H
Aircraft:	WP-3D/N42RF
Departed:	Acapulco, Mexico, at 13/1504 GMT
Arrived:	Acapulco, Mexico, at 14/0051 GMT
Purpose:	Rainband and water budget experiments - T. S. TICO (E. Pacific).
Pattern:	See Fig. 5/pattern III, option 1; pattern X, option 2; altitudes 0.3, 0.1, 2 K ft; then 25 K ft. Two-aircraft daylight mission, with N42RF making 10 passes. Due to development, switched to rainband and water budget pattern at 13/2120 GMT.

FILM LOG

Camera Roll	From [Day/Time (GMT)]		To [Day/Time (GMT)]
Forward	1/1	13/1504	14/0051
Left-side	1/1	13/1504	14/0051
Right-side	1/1	13/1504	14/0051

TAPE LOG: 831013H

Tape Type	Number	From [Day/Time (GMT)]	To [Day/Time (GMT)]
RFC Standard	1/01	13/1434	14/0047
Radar	1/16	13/1547	13/1557
Radar	2/16	13/1557	13/1621
Radar	3/16	13/1621	13/1649
Radar	4/16	13/1649	13/1722
Radar	5/16	13/1722	13/1749
Radar	6/16	13/1750	13/1821
Radar	7/16	13/1821	13/1848
Radar	8/16	13/1855	13/1913
Radar	9/16	13/1936	13/2004
Radar	10/16	13/2004	13/2042
Radar	11/16	13/2042	13/2109
Radar	12/16	13/2121	13/2147
Radar	13/16	13/2148	13/2216
Radar	14/16	13/2216	13/2243
Radar	15/16	13/2244	13/2309
Radar	16/16	13/2309	13/2338
Knollenberg	1/26	13/1550	13/1618
Knollenberg	2/26	13/1618	13/1733
Knollenberg	3/26	13/1733	13/1753
Knollenberg	4/26	13/1753	13/1818
Knollenberg	5/26	13/1818	13/1840
Knollenberg	6/26	13/1840	13/1905
Knollenberg	7/26	13/1905	13/1931
Knollenberg	8/26	13/1931	13/1952
Knollenberg	9/26	13/1952	13/2018
Knollenberg	10/26	13/2018	13/2036
Knollenberg	11/26	13/2036	13/2054
Knollenberg	12/26	13/2054	13/2125
Knollenberg	13/26	13/2125	13/2132
Knollenberg	14/26	13/2132	13/2140
Knollenberg	15/26	13/2140	13/2145
Knollenberg	16/26	13/2145	13/2152
Knollenberg	17/26	13/2152	13/2158
Knollenberg	18/26	13/2158	13/2203
Knollenberg	19/26	13/2203	13/2209
Knollenberg	20/26	13/2209	13/2215
Knollenberg	21/26	13/2215	13/2221
Knollenberg	22/26	13/2221	13/2227
Knollenberg	23/26	13/2228	13/2248
Knollenberg	24/26	13/2248	13/2325
Knollenberg	25/26	13/2325	14/0009
Knollenberg	26/26	14/0009	14/0040
Slow	1/01	13/1434	14/0047

EQUIPMENT STATUS: 831013H

SYSTEM	STATUS /	UP	DOWN	NOT USED	REMARKS
NAV	INE 1	X			
	INE 2	X			
	ONE	X			1740 GMT INE#1 only
	DOPL	X			
RADAR	NOSE			X	
	LF	X			1715 GMT AFC inop.
	TAIL	X			
	DOPPLER			X	
	DATA SYSTEM	X			1930 GMT halt; 2040 reset
RAMS	DATA SYSTEM	X			
	TOTAL TEMP. 1	X			
	TOTAL TEMP. 2	X			
	DEW POINT	X			
	ATTACK ANGLE	X			
	SLIP ANGLE	X			
	ABS. PRESS.	X			
	DIFF. PRESS.	X			
	RADAR ALT.	X			
	J & W	X			
PMS	OAP 2DP	X			
	OAP 2DC	X			Inop. after T/O
	FSSP 100	X			
	DATA SYSTEM	X			
IPC				X	
FOIL				X	
CO_2 RADIOMETER		X			
MICRO. RADIOMETER				X	
SFC. RADIOMETER		X			
FORMVAR				X	
PHOTOGRAPHY	FWD	X			
	LS	X			
	RS	X			
	DWN			X	
AXBT	TUBES			X	
	RECEIVERS			X	
ODW				X	

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