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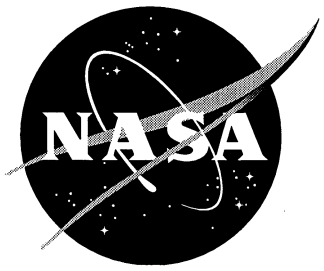

Compendium of NASA Data Base for the Global Tropospheric Experiment's Pacific Exploratory Mission - Tropics B (PEM-Tropics B)

Volume 1: DC-8

A. Donald Scott, Jr., Mary M. Kleb, and James L. Raper
Langley Research Center, Hampton, Virginia

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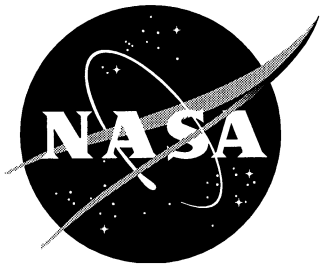

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National Aeronautics and
Space Administration

Langley Research Center
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December 2000

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COMPENDIUM OF NASA DATA BASE FOR THE GLOBAL TROPOSPHERIC EXPERIMENT'S PACIFIC EXPLORATORY MISSION – TROPICS B (PEM-TROPICS B)

By A. Donald Scott, Jr., Mary M. Kleb, and James L. Raper
Langley Research Center

SUMMARY

This report provides a compendium of NASA aircraft data that are available from NASA's Global Tropospheric Experiment's (GTE) Pacific Exploratory Mission – Tropics B (PEM-Tropics B) conducted in March and April 1999. The PEM-Tropics B mission provided the scientific community an opportunity to continue the investigation of tropospheric chemistry over the north and south tropical Pacific Oceans. Conducted during March and April 1999, PEM-Tropics B was an airborne study that complimented the PEM-Tropics A mission. It provided an opportunity to investigate chemical and transport properties of the tropical troposphere during contrasting meteorological conditions. PEM-Tropics B was conducted during the southern-tropical wet season when the influence from biomass burning observed in PEM-Tropics A was minimal. Major deployment sites were Hawaii, Kiritimati (Christmas Island), Tahiti, Fiji, and Easter Island. The broad goals of PEM-Tropics B were to improve understanding of the oxidizing power of the atmosphere and the processes controlling sulfur aerosol formation. In addition it was also an effort to continue to establish baseline values for chemical species that are directly coupled to the oxidizing power and aerosol loading of the troposphere.

PEM-Tropics B was conducted as part of the National Aeronautics and Space Administration's (NASA) Global Tropospheric Experiment (GTE). The GTE is an ongoing element of the Tropospheric Chemistry Program, a Research and Analysis

(R&A) program within the Science Division of NASA's Office for Earth Science Enterprise. PEM-Tropics B included measurements aboard NASA's DC-8 and P-3B aircraft. The major thrust of GTE has been to utilize NASA's DC-8 and P-3B aircraft to carry multi-instrument payloads into regions of the global troposphere where natural and/or human impacts are believed to be particularly significant in effecting chemical composition changes and/or where the troposphere is still relatively unaffected.

The format of this compendium utilizes data plots (time series) of selected data acquired aboard the NASA/Dryden DC-8 (vol. 1) and NASA/Wallops P-3B (vol. 2) aircraft during PEM-Tropics B. The purpose of this document is to provide a representation of aircraft data that will be available in archived format via NASA Langley's Distributed Active Archive Center (DAAC) or are available through the GTE Project Office archive. The data format is not intended to support original research/analyses, but to assist the reader in identifying data that are of interest. This compendium is for only the NASA aircraft data. The DAAC archived data bases will include numerous supporting data including meteorological observations/products, results from surface studies, satellite observations, and data from ozonesonde and rawin sonde releases.

INTRODUCTION

The goal of the NASA Tropospheric Chemistry Program is to develop an understanding of the chemical cycles that control the composition of the troposphere and to assess the susceptibility of the global atmosphere to chemical change. A major component of the NASA program is the **G**lobal **T**ropospheric **E**xperiment (GTE), which consists of a series of field experiments designed to (1) evaluate the capability of instrument techniques to measure, under field conditions, the minute concentrations of key chemical species in the troposphere; and (2) systematically address tropospheric chemistry issues relevant to global change, through airborne sampling expeditions, coupled with modeling and laboratory studies. GTE is primarily an aircraft-based program supplemented by ground-based measurements. Satellite data also play important roles. Space Shuttle observations of tropospheric carbon monoxide distributions have been used to plan and direct the course of expeditions, for example, over tropical rain forests and for continental outflow into the tropical Atlantic Ocean. LANDSAT land-surface images have facilitated the extrapolation of regional Arctic-tundra measurements into global-scale conclusions. **T**otal **O**zone **M**easurements from **S**atellites (TOMS) has helped place GTE observed ozone distributions/budgets into a global perspective (temporal and spatial) and has been used to guide intensive aircraft studies over the tropical Atlantic Ocean. Weather data returned by environmental satellites have guided flight planning for research flights. The **D**istributed **A**ctive **A**rchive **C**enter (DAAC) data include many of the satellite, surface, and meteorological products used to support GTE missions or analyses.

The GTE airborne expeditions have focused on studies of the remote global atmosphere in order to provide well-documented baseline measurements of the unperturbed environment and to fully understand the chemical cycles underlying the natural environment. Table 1 and Figure 1 summarize GTE missions conducted through 1999. The GTE expeditions have been conducted in a diverse range of environments and with different scientific goals. The **C**hemical **I**nstrument **T**est and **E**valuation (CITE) series was designed to study the ability to measure key tropospheric gaseous species by exposing selected instrumentation to a wide range of measurement conditions. The

Atmospheric **B**oundary **L**ayer **E**xperiments (ABLE) were designed to study the emission, chemical processes, and dynamics of the boundary layer, and have been conducted over ecosystems known to have significant influence on the global troposphere. The importance of long-range transport of natural and anthropogenic emissions on the global troposphere has been investigated in the **P**acific **E**xploratory **M**issions (PEM) and the **T**ransport and **A**tmospheric **C**hemistry near the **E**quator – **A**tlantic (TRACE-A). The Pacific Exploratory Missions in the Western Pacific Ocean (PEM-West) Phases A and B focused on the impact of emissions from the Asian continent over the northwest Pacific Ocean during contrasting meteorological conditions. The Pacific Exploratory Missions over the Tropical Pacific (PEM-Tropics) Phases A and B studied the oxidizing power of the atmosphere and sulfur chemistry over the Pacific basin also during contrasting seasons.

The GTE, managed as part of the Tropospheric Chemistry Program in the Mission to Planet Earth Office, NASA Headquarters, was initiated in the early 1980s. Implementation of the GTE Project is via a Project Office at the NASA Langley Research Center, Atmospheric Sciences Competency.

SYMBOLS AND UNITS

ABLE	Atmospheric and Boundary Layer Experiment
CITE	Chemical Instrument Test and Evaluation
DAAC	Distributed Active Archive Center
GTE	Global Tropospheric Experiment
ITCZ	Inter-Tropical Convergence Zone
LaRC	Langley Research Center
NASA	National Aeronautics and Space Administration
PEM	Pacific Exploratory Mission
ppbv	parts per billion, by volume
ppmv	parts per million, by volume

pptv	parts per trillion, by volume
SPCZ	South Pacific Convergence Zone
TOMS	Total Ozone Measurements from Satellites
TRACE-A	Transport and Atmospheric Chemistry near the Equator – Atlantic

PROGRAM AND DATA DESCRIPTION

The National Aeronautics and Space Administration's PEM-Tropics B mission, conducted in March and April 1999, was a major component of the Global Tropospheric Experiment, a project within the Earth Sciences Enterprise program. The long-range goal of the GTE is to contribute substantially to scientific understanding of human impacts on the chemistry of the global troposphere. Changes in chemical composition of the troposphere on a global scale have been well documented during these last two decades and have given rise to considerable concern that these chemical changes in the troposphere, which are expected to increase as population increases and economic activity expands, will lead to changes in the earth's climate. The PEM-Tropics B campaign had two main objectives, (1) Provide baseline data for chemical species that determine the oxidizing power and aerosol loading of the tropical Pacific, and (2) Evaluate the chemical and dynamic factors controlling ozone, OH, and aerosol levels over this remote region. Within this framework, 5 specific tasks were identified: (1) quantify the fast photochemical processes controlling OH concentrations, (2) investigate the factors responsible for large-scale low concentrations of tropospheric ozone over the equatorial Pacific, (3) study the role of the ITCZ and SPCZ as barriers to atmospheric transport between the Northern and Southern Hemispheres and within the South Pacific, (4) investigate the scavenging of gases/aerosols associated with deep convection and gas-to-aerosol conversion taking place in convective outflows, and (5) elucidate the processes controlling photochemistry and aerosol formation beneath the trade wind inversion.

The broad design of the PEM-Tropics B campaign employed a series of flights utilizing the NASA Dryden DC-8 and NASA Wallops P-3B aircraft from remote operational sites in the South Pacific Basin. The DC-8's operational sites were Hilo, Hawaii; Nadi, Fiji; Papeete, Tahiti; and Easter Island. The P-3B's operational sites included Christmas Island and Papeete, Tahiti. From these primary bases, flights covered a latitude range of about 20°N to 30°S and 165°E to 95°W in longitude. Table 2a summarizes the DC-8 flights and Table 2b summarizes the P-3B flights. DC-8 flight tracks are shown in Figure 2a while the P3B flight tracks are shown in Figure 2b. Flights 1 through 4 for the DC-8 and flights 1 and 2 for the P-3B, all test flights, are not included in Figure 2a or 2b, respectively. DC-8 flights 6-8, 10-12, 14-18, and 20 were site-intensive flights based out of Hawaii, Fiji, Tahiti, and Easter Island, respectively. DC-8 ferry/transit flights included (a) flight 5 from Dryden to Hawaii; (b) flight 9 from Hawaii to Fiji; (c) flight 13 from Fiji to Tahiti; (d) flight 19 from Tahiti to Easter Island; and flights 21 and 22 from Easter Island to Dryden (via Costa Rica). P-3B flights 6-11 and 13-16 were site intensive flights from Christmas Island and Tahiti, respectively. P-3B ferry/transit flights included (a) flights 3-5 from Wallops to Christmas Island (via Dryden and Hawaii); (b) flight 12 from Christmas Island to Tahiti; and (c) flights 17-19 from Tahiti to Wallops (via Hawaii and Monterey, California). Data archival was optional for flights 2-4 for both the DC-8 and P-3B. Flight plans consisted of combinations of controlled rate of ascent or descent spirals, ramp-up or ramp-down flight legs, and constant altitude flight legs selected to meet the scientific objectives of each flight. In general, 8 to 10 hour missions were flown on the DC-8 covering an altitude range of 300 meters to 10 km. P-3B flight missions ranged from 6 to 10 hours covering an altitude range of about 150 meters to 7 km.

The DC-8 transit flight from Dryden to Hilo investigated northern tropical chemistry. The Hilo, Hawaii based flights focused primarily on photochemistry. Flights 6 and 8 studied sunrise and sunset photochemistry, respectively. Flights 7 and 9 examined equatorial chemistry and equatorial photochemistry, respectively. Fiji flights (10 – 12) investigated the SPCZ, ozone trough, and photochemical aging of air. The Fiji to Tahiti transit flight, 13, was a general equatorial survey. The first Tahiti local flight, flight 14, characterized southern latitudes. Tahiti flights 15 and 16 focused on sunrise and sunset

HO_x/NO_x photochemistry, respectively. The remainder of the DC-8 flights were designed to study transport; ITCZ inflow/outflow (flight 17), frontal crossing characterization (flight 18), tropical convective outflow (flight 19), South American outflow (flight 20), South/Central American outflow (flight 21), and Central American outflow (flight 22).

The P-3B science objectives fucused primarily on HO_x photochemistry, sulfur and aerosol chemistry. The Dryden to Hilo transit flight (flight 4) studied the transport of US pollution. During the flight from Hilo to Christmas Island interhemispheric gradients were studied. Many of the Christmas Island flights were designed to assess HO_x and DMS chemistry. Flights 6-8 examined sunset and sunrise HO_x and DMS. Flight 9, from Christmas Island, was an equatorial survey. Flight 10 investigated equatorial upwelling and sunrise DMS and flight 11 focused on equatorial HO_x. The transit flight from Christmas Island to Tahiti (flight 12) studied interhemispheric trace gas gradients. Tahiti local flights 13 and 15 focused on convective clouds, specifically gas/particle conversion. Tahiti local flight 14 examined low-to-mid altitude HO_x. The last Tahiti local flight (16) focused on sunrise sulfur flux and DMS oxidation. The transit flight from Tahiti to Honolulu investigated boundary layer HO_x chemistry. The Honolulu to Monterey, CA and Monterey, CA to Wallops transit flights studied long-range Asian and North American outflow and continental layers, respectively.

The core set of measurements aboard the aircraft focused on evaluating the oxidizing power and aerosol loading of the atmosphere and transport properties of the remote South Pacific. The aircraft data include a suite of chemical measurements which include, but are not limited to, ozone, nitrogen oxide, nitrogen dioxide, nitric acid, nitrous oxide, peroxy acetyl nitrate (PAN), methane, carbon monoxide, carbon dioxide, peroxide, hydroperoxyl radical, sulfur dioxide, sulfuric acid, aerosols, actinic flux, water, halocarbons, alkyl nitrates, dimethyl sulfide (DMS), and dimethyl sulfoxide (DMSO), among others. Table 3 lists the investigators and measurements for the DC-8 and Table 4 lists the same for the P-3B. Archived parameters are given in Table 5. For a complete list of plotted parameters, see Table 6.

The PEM-Tropics B data is not yet avaliable on the Langley DAAC. At a time yet to be determined, the PEM-Tropics B DAAC data archive will include (1) data taken aboard the DC-8 aircraft; (2) data taken aboard the P-3B aircraft; and (3) ozonesonde data. The ozonesonde network was formed and began measurements during the pre-deployment phase of PEM-Tropics B. The ozonesonde data include releases from the following locations prior to mission deployment: Easter Island, Chili; Papeete, Tahiti; Pago Pago, American Samoa; Suva, Fiji; and Lauder, New Zealand. All PEM-Tropics B data is currently available on the GTE archive.

The data plots for the PEM-Tropics B are given in Appendix A. For each DC-8 flight, 13 pages of time series plots are provided: page 1 – a latitude/longitude plot of the flight region and time series plots of altitude, temperature, relative humidity, and water vapor; page 2 – ozone (O_3), carbon monoxide (CO), methane (CH_4), carbon dioxide (CO_2), and hydroxyl radical (OH); page 3 – nitric oxide (NO), nitric acid (HNO_3), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), and dimethyl sulfide (DMS); page 4 – ethyne (C_2H_2), ethene (C_2H_4), propane (C_3H_8), propene (C_3H_6), and ethane (C_2H_6); page 5 – propane/ethane, ethene/ethane, ethyne/carbon monoxide, ethene/carbon monoxide, and ethane/carbon monoxide; page 6 – carbon tetrachloride (CCl_4), perchloroethylene (C_2Cl_4), methyl chloroform (CH_3CCl_3), methyl iodide (CH_3I), and methyl chloride (CH_3Cl); page 7 – chloroform ($CHCl_3$), calcium (Ca^+), ultrafine aerosol (ULTRA), unheated fine aerosol (FINE-UNht), and fine aerosol ratio (FINE RATIO); page 8 – peroxide (H_2O_2), methyl hydro peroxide (CH_3OOH) and acetone (CH_3COCH_3), hydroperoxyl radical (HO_2), beryllium-7 (^7Be), and formaldehyde (CH_2O); page 9 – nitrate (NO_3^-), chloride (Cl^-), methyl sulfonate (MS), sulfate (SO_4^-), and ammonium (NH_4^+); page 10 – methyl nitrate (CH_3ONO_2), ethyl nitrate ($C_2H_5ONO_2$), isopropyl nitrate (i-$C_3H_7ONO_2$), n-propyl nitrate (n-$C_3H_7ONO_2$), and peroxy acetyl nitrate (PAN); page 11 – HCFC-141B (CH_3CFCl_2), HCFC-142B (CH_3CF_2Cl), HCFC-22 (CHF_2Cl), methylene bromide (CH_2Br_2), and bromoform ($CHBr_3$); page 12 – ozone photolysis frequency ($J(O_3)$), nitrogen dioxide photolysis frequency ($J(NO_2)$), peroxide photolysis frequency ($J(H_2O_2)$), nitrogen dioxide photolysis frequency-zenith viewing ($J(NO_2)z$), and nitrogen dioxide photolysis frequency-nadir viewing ($J(NO_2)n$); page 13 – altitude, cabin altitude, roll angle, sun

elevation, and methylene chloride (CH_2Cl_2). The species were selected to provide the reader with information on both the source characteristics and photochemical history of air. There are no plots prior to flight 5 for the DC-8 or flight 3 for the P-3B, as these were test flights and data archival was not required. Data plots are in standardized format as discussed in Appendix A. The DAAC archive will and GTE archive already does include other measurements aboard the DC-8 and P-3B during PEM-Tropics B which are not plotted in Appendix A.

CONCLUDING REMARKS

This compendium of data from NASA's Global Tropospheric Experiment's Pacific Exploratory Mission to the Tropics, Phase B (PEM-Tropics B) provides only a graphical representation of aircraft data that will be available in archived format from NASA Langley's Distributed Active Archive Center (DAAC) and currently are available from the GTE Project Office archive. The time series plots are not intended to support original research/analysis, but serve as an overview of the PEM-Tropics B aircraft data and provide some assistance to the reader in identifying data that are of interest and which may be obtained from Langley's DAAC archive or GTE's Project Office archive. This compendium covers only selected NASA DC-8 and P-3B aircraft data. The GTE archived data base includes other data measured on board the aircraft as well as numerous supporting data including meteorological observations/products, photochemical modeling products, surface station observations, satellite observations, and ozonesonde and rawin sonde releases. GTE-sponsored analyses/results from the PEM-Tropics B expeditions have been submitted (August 2000) to a Special Issue of the *Journal of Geophysical Research – Atmospheres*.

Questions or information regarding the Langley DAAC archive should be directed to Langley DAAC User and Data Services, Mail Stop 157D, NASA Langley Research Center, Hampton, Virginia, 23681-0001. A brief description of the DAAC, log on procedures, and data bases is given in Appendix B.

Table 1. GTE Field Expeditions Through 1999

Expedition	Date	General Geographic Region	Time of Year
CITE-1	1983	Hawaii	November
CITE-1	1984	Eastern North Pacific – off the California coast	April
ABLE-1	1984	Barbados, French Guyana	June
ABLE-2A	1985	Amazon Basin	August
CITE-2	1986	Western USA	August
ABLE-2B	1987	Amazon Basin	May
ABLE-3A	1988	Alaska – Barrow, Bethel, Cold Bay	July/August
CITE-3	1989	Western North Atlantic – Virginia coast and Western South Atlantic – Brazil coast	August/September
ABLE-3B	1990	Canada – Hudson Bay, Schefferville	July/August
PEM-West A	1991	Western Pacific Rim	October
TRACE-A	1992	Brazil, South Atlantic, Southwest Africa	September
PEM-West B	1994	Western Pacific Rim	February/March
PEM-Tropics A	1996	South Pacific Basin	August/September
PEM-Tropics B	1999	South Pacific Basin	March/April

Table 2(a). Summary of PEM-Tropics B DC-8 Aircraft Flights

Flight No.	Start Date (GMT)	Julian Day (GMT)	Start Time (GMT)	Stop Time (GMT)	Lat. Min (Degs)	Lat. Max (Degs)	Lon. Min (Degs)	Lon. Max (Degs)	Flight Location and Description
1D	02/08/1999	39	10:00:00	12:00:00					NASA DFRC Local Engineering Check Flight
2D#	02/19/1999	50	19:14:30	23:06:22	26.3833	35.7167	-123.95	-117.1	NASA DFRC Local Test Flight # 1
3D#	02/24/1999	55	19:07:29	23:21:42	27.4333	35.2167	-122.55	-117.0833	NASA DFRC Local Test Flight # 2
4D#	03/03/1999	62	18:18:00	0:29:10	27.7667	35.2333	-122.0333	-117.3667	NASA DFRC Local Test Flight # 3
5D*	03/06/1999	65	19:00:55	2:06:33	19.7167	35.1	-155.033	-117.5667	NASA DFRC to Hilo, HI - Northern Tropical Chemistry
6D*	03/09/1999	68	14:09:00	22:40:17	13.7667	19.85	-155.05	-149.0167	Hilo Local # 1 - Sunrise Photochemistry
7D*	03/13/1999	72	19:59:28	5:12:42	-1.3833	19.7833	-165.35	-154.15	Hilo Local # 2 - Equatorial Chemistry
8D*	03/15/1999	74	20:59:11	6:41:16	0	19.7167	-157.4	-152.4833	Hilo Local # 3 - Sunset Photochemistry
9D*	03/17/1999	76	20:27:00	6:33:50	-17.95	19.7167	176.967	-154.883	Hilo, HI to Fiji - Equatorial Photochemistry
10D*	03/20/1999	79	22:25:00	6:11:41	-24.0333	-9.7667	176.783	-174.983	Fiji Local # 1 - SPCZ
11D*	03/22/1999	81	21:17:00	7:37:40	-19	7.1333	148.5333	177.433	Fiji Local # 2 - Ozone Trough
12D*	03/24/1999	83	21:20:22	5:30:45	-17.8833	-1.7	165.9167	177.9667	Fiji Local # 3 - Photochemical Aging of Air
13D*	03/26/1999	85	21:10:56	5:26:36	-22.7	-3.1	177.2	-149.6	Fiji to Tahiti - Equatorial Survey
14D*	03/30/1999	89	20:34:12	4:30:48	-36.3333	-16.6333	-149.6167	-131.2333	Tahiti Local #1 - Southern Latitudes Characterization
15D*	04/02/1999	92	14:26:27	22:13:13	-18.1167	-11.9	-152.2	-147.7833	Tahiti Local # 2 - Sunrise HOx/NOx Chemistry
16D*	04/04/1999	94	22:55:36	7:06:53	-22.1	-17.55	-150.1	-146.5333	Tahiti Local # 3 - Sunset HOx/NOx Chemistry

Table 2(a). Concluded

Flight No.	Start Date (GMT)	Julian Day (GMT)	Start Time (GMT)	Stop Time (GMT)	Lat. Min (Degs)	Lat. Max (Degs)	Lon. Min (Degs)	Lon. Max (Degs)	Flight Location and Description
18D*	04/10/1999	100	20:10:03	4:05:18	-33.1167	-13.9667	-155.3667	-148.4833	Tahiti Local # 5 - Frontal Crossing Characterization
19D*	04/13/1999	103	22:39:33	6:53:32	-27.15	-4.9833	-149.583	-109.433	Tahiti to Easter -Tropical Convective Outflow
20D*	04/15/1999	105	14:28:23	23:47:24	-27.1833	-5	-119.55	-108.9833	Easter Local # 1 - South American Outflow
21D*	04/17/1999	107	14:03:05	22:41:45	-27.2667	10	-109.5167	-84.1833	Easter to Costa Rica - South/Central American Outflow
22D*	04/18/1999	108	17:06:38	23:22:12	9.9333	34.9833	-117.8833	-84.1167	Costa Rica to Dryden - Central American Outflow

* Data archival is required # Data archival is optional

Table 2(b). Summary of PEM-Tropics B P-3B Aircraft Flights

Flight No.	Start Date (GMT)	Julian Day (GMT)	Start Time (GMT)	Stop Time (GMT)	Lat. Min (Degs)	Lat. Max (Degs)	Lon. Min (Degs)	Lon. Max (Degs)	Flight Location and Description
1P	03/04/1999	63	20:38:05	1:29:45	36.1084	37.94	-75.4974	-72.6053	NASA WFF Test Flight # 1
2P#	03/07/1999	66	17:57:34	23:41:58	37.0659	37.9881	-75.5101	-75.6333	NASA WFF Test Flight # 2
3P#	03/10/1999	69	19:35:30	3:09:35	34.7976	38.0023	-117.8659	-75.4394	NASA WFF to NASA DFRC Test Flight # 3
4P#	03/11/1999	70	19:33:44	3:00:54	19.7225	35.0099	-155.0753	-117.8218	NASA DFRC to Hilo,HI Transport of US Polution
5P*	03/13/1999	72	18:59:24	3:14:23	-0.0854	19.7223	-157.6726	-154.9066	Hilo,HI to Christmas Island Interhemispheric Gradients
6P*	03/15/1999	74	20:39:51	5:08:08	0.9191	2.325	-157.763	-154.5006	Christmas Island Local # 1 Sunset BL, HOx and DMS Flux
7P*	03/17/1999	76	14:33:05	20:09:11	-1.0906	1.992	-157.4252	-156.6062	Christmas Island Local # 2 Sunrise to Sunset HOx & DMS
8P*	03/17/1999	76	22:34:30	4:27:25	-1.4238	2.0158	-157.4005	-156.5	Christmas Island Local # 3 Sunrise to Sunset HOx & DMS
9P*	03/20/1999	79	16:59:50	1:14:35	-0.0237	2.0256	-157.3806	-139.9772	Christmas Island Local # 4 Equatorial Survey
10P*	03/22/1999	81	14:44:56	0:53:10	-0.6021	1.9928	-157.4448	-152.8383	Christmas Island Local # 5 Equatatorial Upwelling & Sunrise DMS
11P*	03/24/1999	83	21:38:27	5:34:35	-1.2889	1.9866	-157.3983	-155.8228	Christmas Island Local # 6 Equatorial HOx
12P*	03/26/1999	85	18:51:37	3:02:45	-17.7163	1.9348	-165.9883	-149.6086	Christmas Island to Tahiti Interhemispheric Trace Gas Grad.
13P*	03/31/1999	90	18:36:15	3:50:55	-17.7302	-5.6551	-149.7854	-142.5973	Tahiti Local # 1 Convective Cloud; Gas/Particle Conversion
14P*	04/04/1999	94	20:54:58	5:17:20	-21.9976	-17.5368	-150.0424	-149.6076	Tahiti Local # 2 Low/Mid-Altitude HOx
15P*	04/05/1999	95	20:00:42	4:02:49	-17.5514	-7.5083	-149.6045	-140.2392	Tahiti Local # 3 Convective Cloud; Gas/Particle Conversion
16P*	04/07/1999	97	14:56:35	1:26:42	-17.6296	-12.3281	-149.7111	-141.7371	Tahiti Local # 4 Sunrise Sulfur Flux & DMS Oxidation

Table 2(b). Concluded

Flight No.	Start Date (GMT)	Julian Day (GMT)	Start Time (GMT)	Stop Time (GMT)	Lat. Min (Degs)	Lat. Max (Degs)	Lon. Min (Degs)	Lon. Max (Degs)	Flight Location and Description
17P*	04/09/1999	99	19:00:37	2:18:28	-17.5546	21.3165	-157.9982	-149.5921	Tahiti to Honolulu, HI BL HOx Chemistry
18P*	04/10/1999	100	19:02:40	1:52:13	21.1883	36.6385	-157.9307	-121.854	Honolulu, HI to Monterey, CA Long Range Asian & NA Outflow
19P*	04/11/1999	101	16:49:58	23:31:40	36.561	39.9023	-121.8413	-75.3355	Monterey, CA to NASA WFF Continental Layers

*Data archival is required # Data archival is optional

Table 3. DC-8 Investigators/Measurements

Principal Investigator	Organization	Parameters
Bruce Anderson	Langley Research Center	CCN
Elliot Atlas	National Center for Atmospheric Research	Alkyl nitrates, halocarbons
Don Blake	University of California-Irvine	NMHC, halocarbons, alkyl nitrates
Ed Browell	Langley Research Center	Nadir & zenith aerosol and ozone profiles
Ed Browell	Langley Research Center	Nadir & zenith aerosol and water vapor profiles
Bill Brune	Pennsylvania State University	OH, HO_2
Gerry Gregory	Langley Research Center	O_3
Brian Heikes	University of Rhode Island	H_2O_2, CH_3OOH, CH_2O
M. J. Mahoney	Jet Propulsion Laboratory	Temperature profiles
Glen Sachse	Langley Research Center	CO, CO_2, CH_4, N_2O, H_2O
Scott Sandholm	Georgia Institute of Technology	NO, NO_2
Rick Shetter	National Center for Atmospheric Research	Nadir & zenith actinic flux
Hanwant Singh	Ames Research Center	PAN, PPN, CH_3ONO_2, C_2Cl_4, tracer species
Bob Talbot	University of New Hampshire	HNO_3, SO_2, aerosols
GTE Project	Langley Research Center/ Dryden Flight Research Center	Latitude, Longitude, Wind speed & direction, Pressure & radar altitude, Cabin altitude, Static & total air temperature, IR surface temperature, Pitch & roll angle, Sun elevation & azimuth, Dew point, Relative humidity, NO_2 photolysis rate, Specific humidity , Forward & nadir cloud video, Storm Scope

Table 4. P-3B Investigators/Measurements

Principal Investigator	Organization	Parameters
Bruce Anderson	Langley Research Center	TAMMS, winds, Lyman-alpha
Elliot Atlas	National Center for Atmospheric Research	Alkyl nitrates, halocarbons
Alan Bandy	Drexel University	SO_2, DMS
Don Blake	University of California-Irvine	NMHC, halocarbons, alkyl nitrates
Antony Clarke	University of Hawaii	Aerosols
Fred Eisele	Georgia Institute of Technology	OH, H_2SO_4, MSA, NH_3, DMSO
Gerry Gregory	Langley Research Center	O_3
Brian Heikes	University of Rhode Island	H_2O_2, CH_3OOH, CH_2O
Brian Ridley	National Center for Atmospheric research	O_3, NO, NO_2
Glen Sachse	Langley Research Center	CO, CO_2, CH_4
Rick Shetter	National Center for Atmospheric Research	Nadir & zenith actinic flux
Bob Talbot	University of New Hampshire	HNO_3, Aerosols
GTE Project	Langley Research Center	Latitude, Longitude, Wind speed & direction, Pressure & radar altitude, Differential pressure, Static pressure, Cabin altitude, Static & total air temperature, Potential temperature, IR surface temperature, Pitch & roll angle, Dew point, Relative humidity, NO_2 photolysis rate, Specific humidity, Storm Scope, Forward & nadir cloud video

Table 5. Archived PEM-Tropics B Parameters

PI	Platform	Number of Parameters	Description
Anderson	DC-8	6	CN aerosol number density (>8 to <1000nm & >18 to <1000nm)(volatile[250C] and non-volatile); CN aerosol size distribution (0.1-3μm & 0.3-20μm)
Anderson-TAMMS	P-3B	17	Static pressure, Pitch & roll angle, True & platform heading, N/S & E/W velocity, Vertical velocity, Latitude, Longitude, Static & virtual potential temperature(theta V), Specific humidity, Variance Theta V & vertical velocity, Variance Lyman Alpha & vertical acceleration
Atlas	P-3B & DC-8	30	Methyl nitrate(CH_3ONO_2), Ethyl nitrate($C_2H_5ONO_2$), Isopropyl nitrate(i-$C_3H_7ONO_2$), N-propyl nitrate(n-$C_3H_7ONO_2$), 2-butyl nitrate(2-$C_4H_90N0_2$), Methylene chloride(CH_2Cl_2), HCFC-141B(CH_3CFCl_2), HCFC-142B(CH_3CF_2Cl), HFC-134A (CH_2FCF_3), Chloroform($CHCl_3$), Methylene bromide(CH_2Br_2), Dibromochloromethane ($CHBr_2Cl$), Bromoform($CHBr_3$), Perchloroethylene (C_2Cl_4), HCFC-22 (CHF_2Cl)
Bandy	P-3B	2	Sulfur dioxide(SO_2), Dimethyl sulfide(DMS)(CH_3SCH_3)
Blake	P-3B & DC-8	116	Methyl Chloride(CH_3Cl), F-12(CCl_2F_2), F-114($CClF_2CClF_2$), F-11(CCl_3F), HCFC-142B (CH_3CF_2Cl), HCFC-141B (CH_3CFCl_2), HCFC 134a(CH_2FCF_3), HCFC 22(CHF_2Cl), Bromochloromethane(CH_2BrCl), Methyl chloroform(CH_3CCl_3), Carbon tetrachloride(CCl_4), Dibromochloromethane ($CHBr_2Cl$), Methylene bromide(CH_2Br_2), Methylene chloride (CH_2Cl_2), Bromodichloromethane($CHBrCl_2$), Perochloroethylene(C_2Cl_4), Bromoform($CHBr_3$), H-1211 ($CBrClF_2$), F-113(CCl_2FCClF_2), H-2402($C_2Br_2F_4$), Methyl Iodide(CH_3I), Dimethylsulfide (DMS)(CH_3SCH_3), Methyl nitrate(CH_3ONO_2), Ethyl nitrate($C_2H_5ONO_2$), i-propyl nitrate(i-$C_3H_7ONO_2$), n-propyl nitrate(n-$C_3H_7ONO_2$), 2-butyl nitrate(2-$C_4H_9ONO_2$), Ethane(C_2H_6), Propene(C_3H_6), i-butane(i-C_4H_{10}), n-butane(n-C_4H_{10}), t-2butene (t-$CH_3CHCHCH_3$), l-butene ($CH_2CHCH_2CH_3$), i-butene (i-C_4H_8), c-2-butene (c-$CH_3CHCHCH_3$), Ethyne(C_2H_2), i-pentane(i-C_5H_{12}), n-pentane(n-C_5H_{12}), Chloroform ($CHCl_3$), Methyl bromide(CH_3Br),

Table 5. Continued

PI	Platform	Number of Parameters	Description
Blake (cont.)	P-3B & DC-8	116	Ethylenedichloride (1 2-$C_2H_4Cl_2$),Ethylene(C_2H_4), Cyclopropane ($CH_2CH_2CH_2$), Propadiene (CH_2CCH_2), Propane (C_3H_8), isoprene ($CH_2CHCCH_3CH_2$), n-hexane ($CH_3C_4H_8CH_3$), cyclohexane (C_6H_{12}), benzene (C_6H_6), ethyl benzene ($C_2H_5C_6H_5$), n-heptane ($CH_3C_5H_{10}CH_3$), toluene ($C_6H_5CH_3$), n-octane ($CH_3C_6H_{12}CH_3$), p-xylene (C_8H_{10}), p - xylene (C_8H_{10}), o-xylene ($C_6H_4C_2H_6$), 2 2 4-trimethylpentane ($C_3H_9CCH_2CHC_2H_6$), 2 3 4-trimethylpentane (C_8H_{18})
Browell-DIAL	DC-8	4	Nadir & zenith aerosol and ozone profiles
Browell-LASE	DC-8	5	Nadir & zenith aerosol and water vapor profiles, Tropopause height
Brune	DC-8	3	Hydroxyl radical(OH), Hydroperoxyl radical(HO_2), HO_2/OH
Clarke	P-3B	30	Heated and unheated fine number density(Dp<13nm), ratio fine heated to unheated, Ultrafine number density(Dp>3nm, 3nm<Dp<10nm), Scattering coefficient @ 450, 550, 700nm (Dp<100nm & Total), Particle absorption coefficient @ 565nm, Size Distribution(number, area and volume dist.)(40, 150, 300C)(10nm<Dp<250nm), Size distribution(number, area, volume dist)(40, 150, 300C)(100nm<Dp<5000nm), LWC
Eisele	P-3B	5	Hydroxyl radical(OH), Sulfuric acid(H_2SO_4), Methane sulfonic acid (MSA) (CH_3SO_3H), Ammonia(NH_3), Dimethyl sulfoxide(DMSO)(CH_3SOCH_3)
Gregory	P-3B & DC-8	2	Ozone(O_3)(10 Hz on DC-8; 1hz on P-3B)
Heikes	P-3B & DC-8	6	Peroxide(H_2O_2), Methyl hydroperoxide(CH_3OOH), Formaldehyde(CH_2O)
Mahoney	DC-8	16	# retrieval levels, Pressure altitude, GPS altitude, Latitude, Longitude, Pitch, Roll, Air temperature, Tropopause #1 altitude, Tropopause #2 altitude, Lapse rate, CM dimension, Combo matrix CM, Std. Error on T, Geometric altitude, Number density
Ridley	P-3B	3	Ozone(O_3), Nitric oxide(NO), Nitrogen dioxide(NO_2)

Table 5. Continued

PI	Platform	Number of Parameters	Description
Sachse	P-3B	2	Carbon monoxide(CO), Carbon dioxide(CO_2)
Sachse	DC-8	6	Carbon monoxide(CO), Carbon dioxide(CO_2), Methane(CH_4), Nitrous oxide (N_2O), Water(H_2O)(1 Hz & 20 Hz)
Sandholm	DC-8	2	Nitric Oxide(NO), Nitrogen dioxide(NO_2)
Shetter	P-3B & DC-8	22+	Nadir & zenith actinic flux f(λ); Photolysis frequencies for: Ozone(O_3), Nitrogen dioxide(NO_2), Formaldehyde(CH_2O), Nitrous acid(HONO), Nitric acid(HNO_3), PAN($CH_3C(O)OONO_2$), Peroxide(H_2O_2), Methylhydroperoxide (CH_3OOH), Methyl nitrate(CH_3ONO_2), Ethyl nitrate($CH_3CH_2ONO_2$), Acetone (CH_3COCH_3)
Singh	DC-8	9	Peroxy acetyl nitrate(PAN)($CH_3C(O)OONO_2$), Peroxy propionyl nitrate(PPN) ($C_2H_5C(O)OONO_2$), Methyl nitrate(CH_3ONO_2), Tetrochloroethylene(C_2Cl_4), Acetone(CH_3COCH_3), Methanol(CH_3OH), Ethanol(C_2H_5OH), Ethyl/i-propyl nitrate($C_2H_5ONO_2$/i-$C_3H_7ONO_2$), Acetaldehyde(CH_3CHO)
Talbot	DC-8	13	Gas Phase: Nitric Acid(HNO_3), Sulfur dioxide(SO_2); Aerosols: Nitrate(NO_3^-), Sulfate(Non-sea-salt)(SO_4^{2-}), Chloride(Cl^-), Methyl Sulfonate(MS)($CH_3SO_3^-$), Sodium(Na^+), Potassium(K^+), Ammonium(NH_4^+), Magnesium(Mg^{2+}), Calcium(Ca_2^+), Lead 210(^{210}Pb), Beryllium 7(^7Be)
Talbot	P-3B	5	Gas Phase: Nitric Acid(HNO_3); Aerosols: Nitrate(NO_3^-), Sulfate(Non-sea-salt)(SO_4^{2-}), Methyl Sulfonate(MS)($CH_3SO_3^-$), Ammonium($NH4^+$)
Project	P-3B	28	Julian day, Time, Latitude, Longitude, Wind speed & direction, Pressure & radar altitude, Differential pressure, Static pressure, Cabin altitude, Static & total air temperature, Potential temperature, IR surface temperature, True air speed, Ground speed, Mach number, Pitch & roll angle, True heading, Track angle, Dew point, Dew point validity, Relative humidity, Saturation vapor pressure, NO_2 photolysis rate, Specific humidity

Table 5. Concluded

PI	Platform	Number of Parameters	Description
Project	DC-8	36	Julian day, Time, Latitude, Longitude, Wind speed & direction, Pressure & radar altitude, Cabin altitude, Static & total air temperature, IR surface temperature, Partial pressure of water vapor, True & indicated air speed, Ground speed, Vertical air speed, Mach number, Pitch & roll angle, True heading, Drift angle, Time & distance to go, Alignment status, Cross track distance, Desired track angle, Track angle error, Track angle, Sun elevation & azimuth, Dew point, Relative humidity, Saturation vapor pressure, NO_2 photolysis rate, Specific humidity

Table 6. Plotted Parameter Chemical Names and Formulas

Formula	Name
Alt	altitude
^{7}Be	beryllium-7
Ca+	calcium
CCl_4	carbon tetrachloride
$CHBr_3$	bromoform
$CHCl_3$	chloroform
CHF_2Cl	HCFC-22
CH_2Br_2	methylene bromide
CH_2Cl_2	methylene chloride
CH_2O	formaldehyde
CH_3CCl_3	methyl chloroform
CH_3CFCl_2	HCFC-141B
CH_3CF_2Cl	HCFC-142B
CH_3COCH_3	acetone
$CH_3C(O)OONO_2$	peroxy acetyl nitrate (PAN)
CH_3Cl	methyl chloride
CH_3I	methyl iodide
CH_3ONO_2	methyl nitrate
CH_3OOH	methyl hydro peroxide
CH_3SCH_3	dimethyl sulfide (DMS)
$CH_3SO_3^-$	methyl sulfonate (MS)
CH_3SOCH_3	dimethyl sulfoxide (DMSO)
CH_3SO_3H	methane sulfonic acid(MSA)
CH_4	methane
Cl^-	chloride
CO	carbon monoxide
CO_2	carbon dioxide
C_2Cl_4	perchloroethylene
C_2H_2	ethyne
C_2H_4	ethene
$C_2H_5ONO_2$	ethyl nitrate
C_2H_6	ethane
C_3H_6	propene
$i\text{-}C_3H_7ONO_2$	isopropyl nitrate
$n\text{-}C_3H_7ONO_2$	n-propyl nitrate
C_3H_8	propane
HNO_3	nitric acid
HO_2	hydroperoxyl radical
H_2O_2	peroxide
H_2SO_4	sulfuric acid
Ht	heated
$J(H_2O_2)$	peroxide photolysis frequency

Table 6. Concluded

Formula	Name
$J(NO_2)$	nitrogen dioxide photolysis frequency
$J(NO_2)z$	nitrogen dioxide photolysis frequency-zenith viewing
$J(NO_2)n$	nitrogen dioxide photolysis frequency-nadir viewing
$J(O_3)$	ozone photolysis frequency
LWC	liquid water content, g/m3
NH_3	ammonia
NH_4^+	ammonium
NO	nitric oxide
NO_2	nitrogen dioxide
NO_3^-	nitrate
OH	hydroxyl radical
O_3	ozone
Pot Temp	potential temperature
Rel Hum	relative humidity
SO_2	sulfur dioxide
SO_4^-	sulfate
Uht	unheated

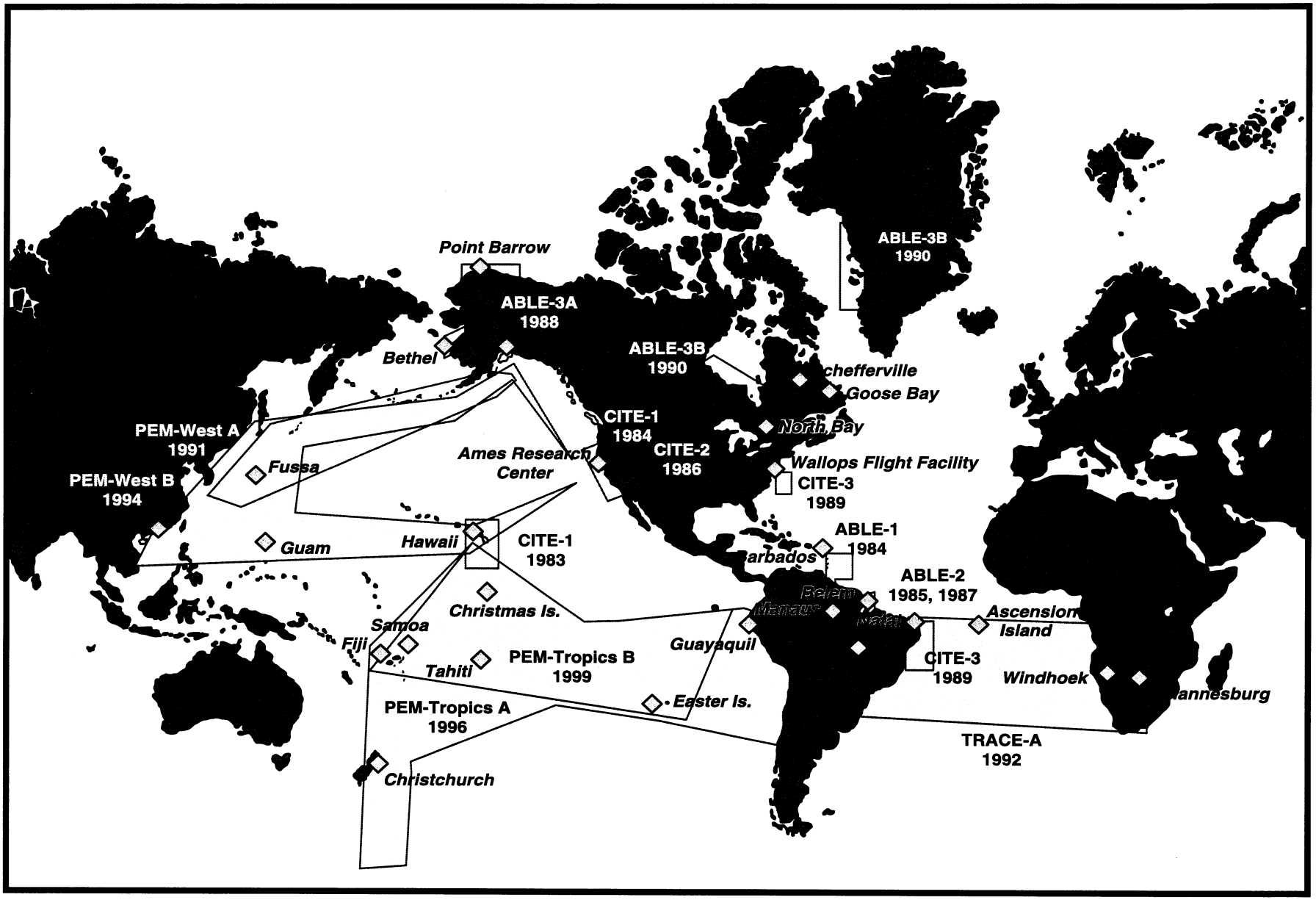

Figure 1. GTE missions through 1999.

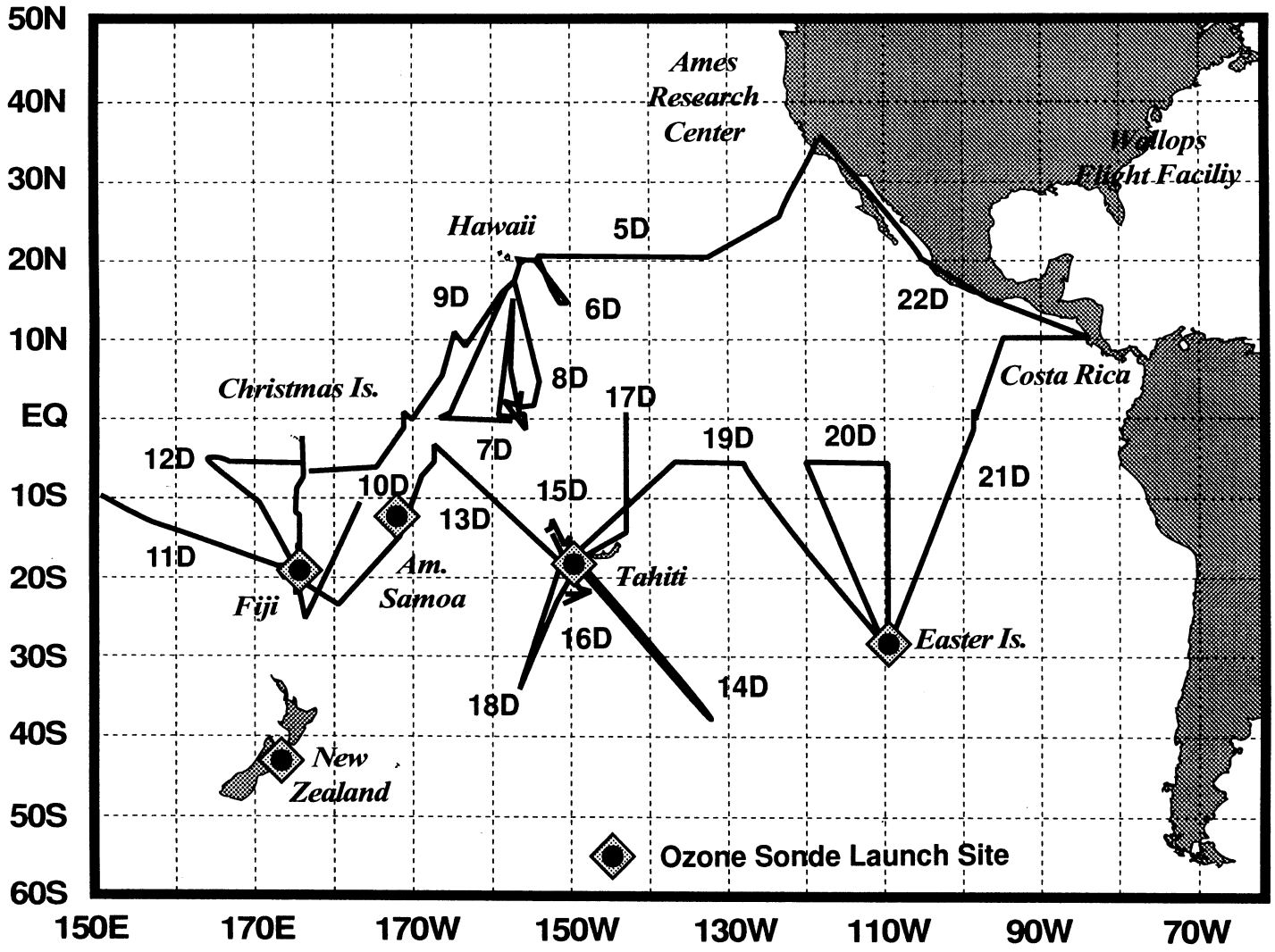

Figure 2(a). PEM-Tropics B DC-8 flight tracks.

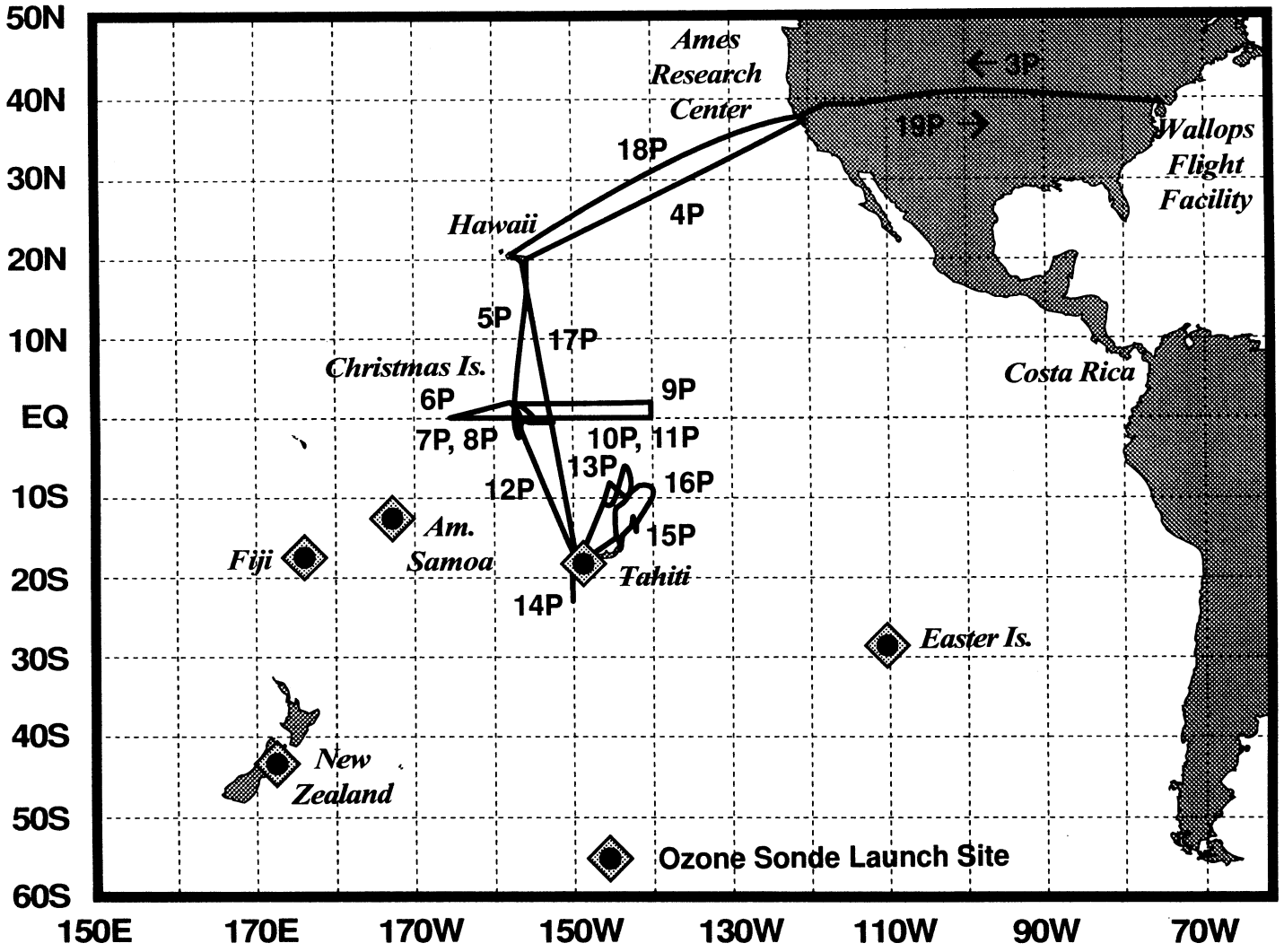

Figure 2(b). PEM-Tropics B P-3B flight tracks.

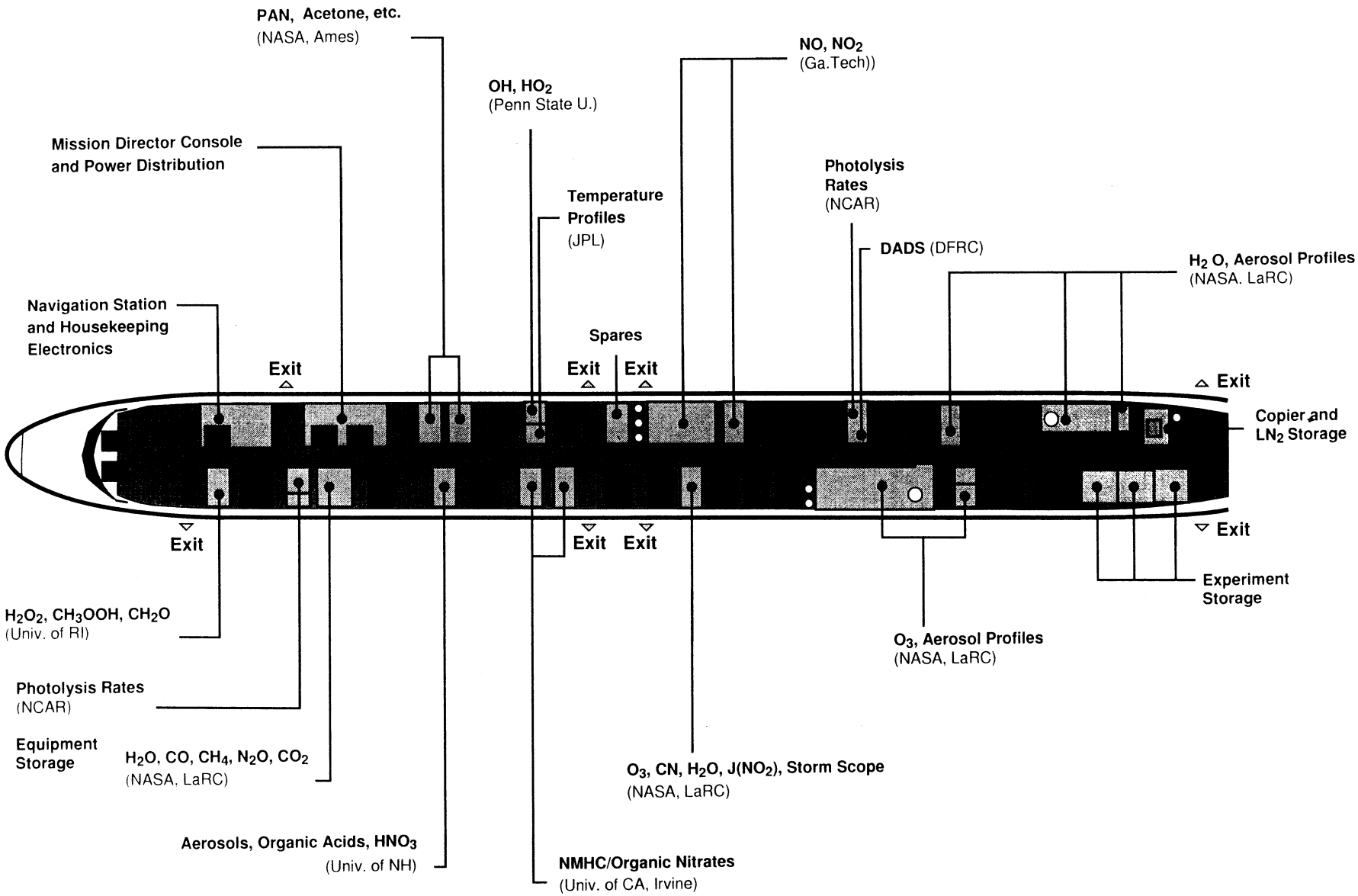

Figure 3(a). PEM-Tropics B DC-8 mission payload floor plan.

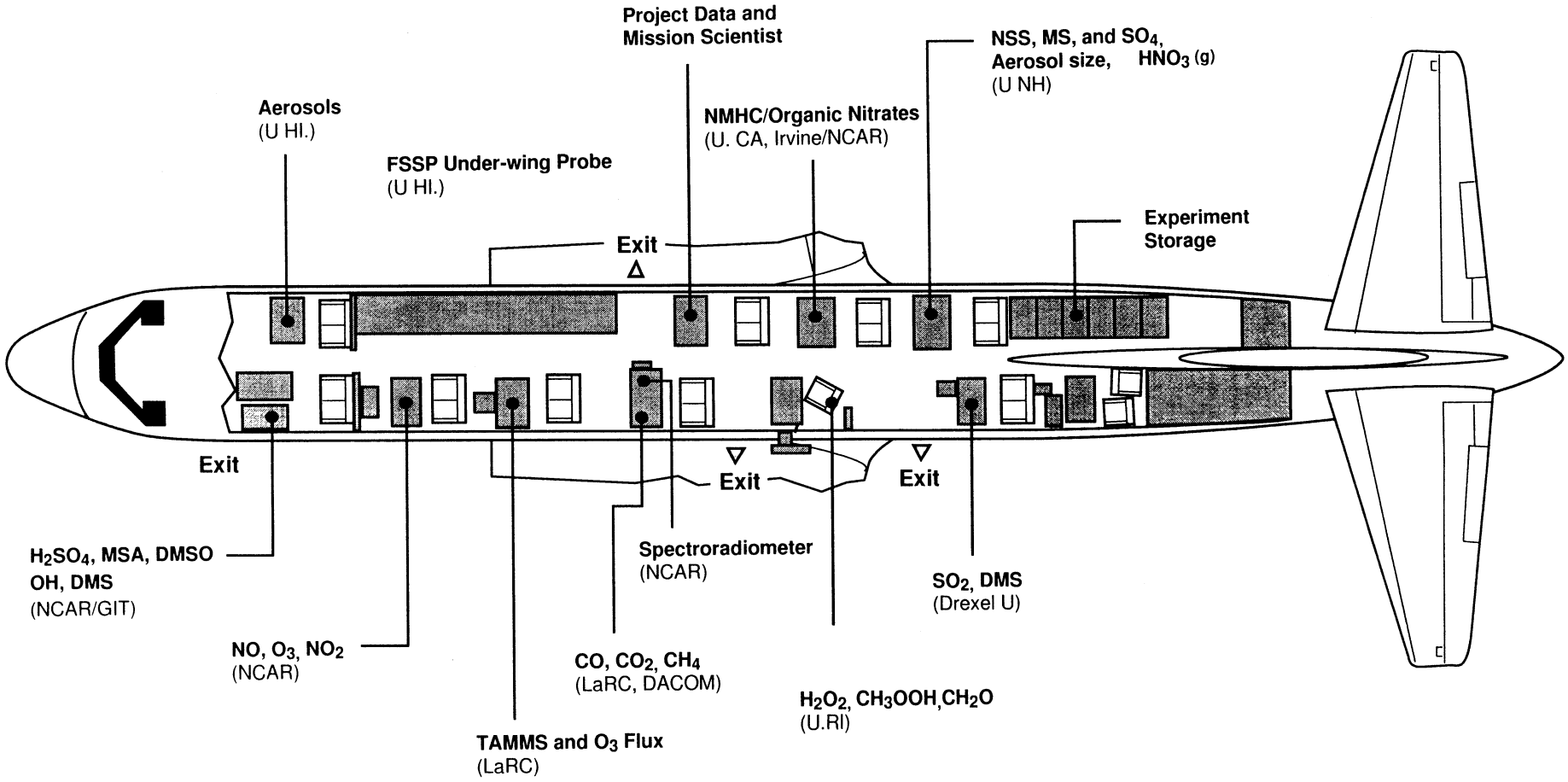

Figure 3(b). PEM-Tropics B P-3B mission payload floor plan.

APPENDIX A

PACIFIC EXPLORATORY MISSION TO THE TROPICS, PHASE B

(PEM-TROPICS B)

Plots are presented in a standardized format, and the data (unedited) are from the Langley GTE archive. Relative humidity is calculated from measurements made on the aircraft. In some cases (mostly for moist, boundary layer conditions) relative humidity may exceed 100% (not plotted) as dew point temperature exceeded air temperature by a few degrees (assumed to be the result of instrument measurement/calibration uncertainty). For time series plots, abscissa time scales for a given flight are identical. Ordinate scales were selected to best represent all the data for a specie measured during the flight. In order to maintain the standardized format, plots for flights in which a specie data were not reported are plotted with the axes and a "NO DATA" entry.

Given below are the beginning page numbers for each flight's sequence of plots:

Flight 5D – page 32

Flight 6D – page 46

Flight 7D – page 60

Flight 8D – page 74

Flight 9D – page 88

Flight 10D – page 102

Flight 11D – page 116

Flight 12D – page 130

Flight 13D – page 144

Flight 14D – page 158

Flight 15D – page 172

Flight 16D – page 186

Flight 17D – page 200

Flight 18D – page 214

Flight 19D – page 228

Flight 20D – page 242

Flight 21D – page 256
Flight 22D – page 270

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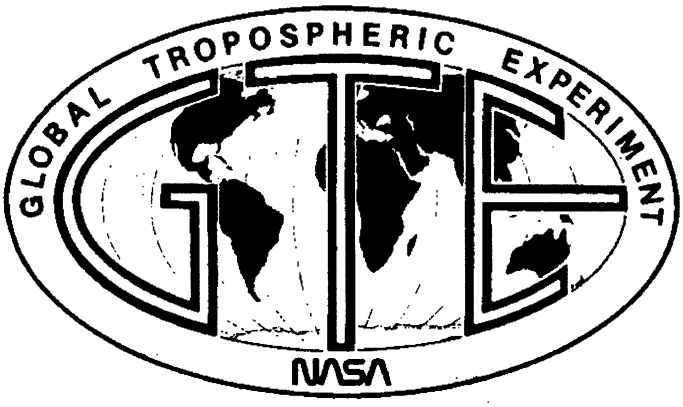
PLOTS OF FINAL CHEMICAL DATA



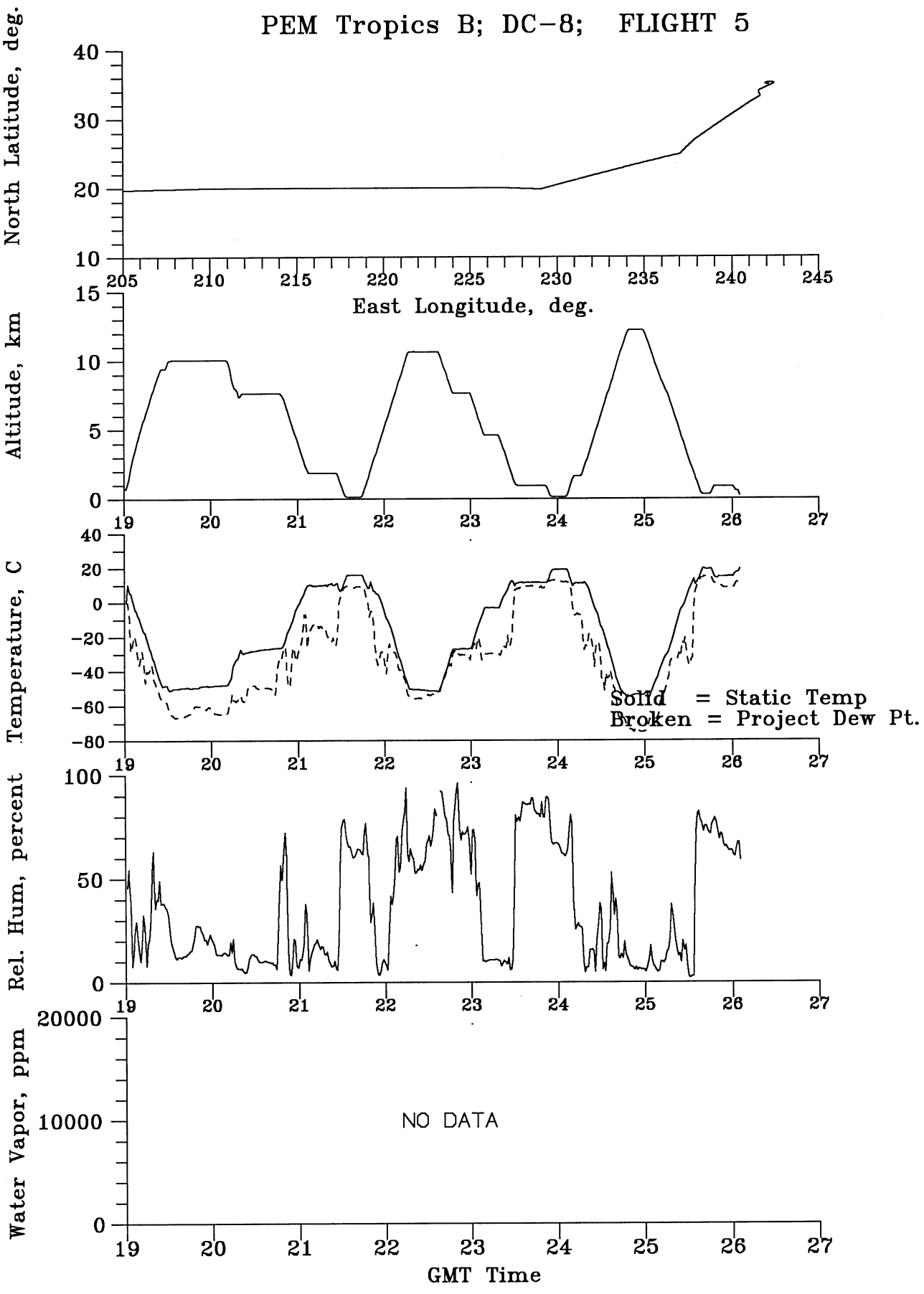
PEM-TROPICS B

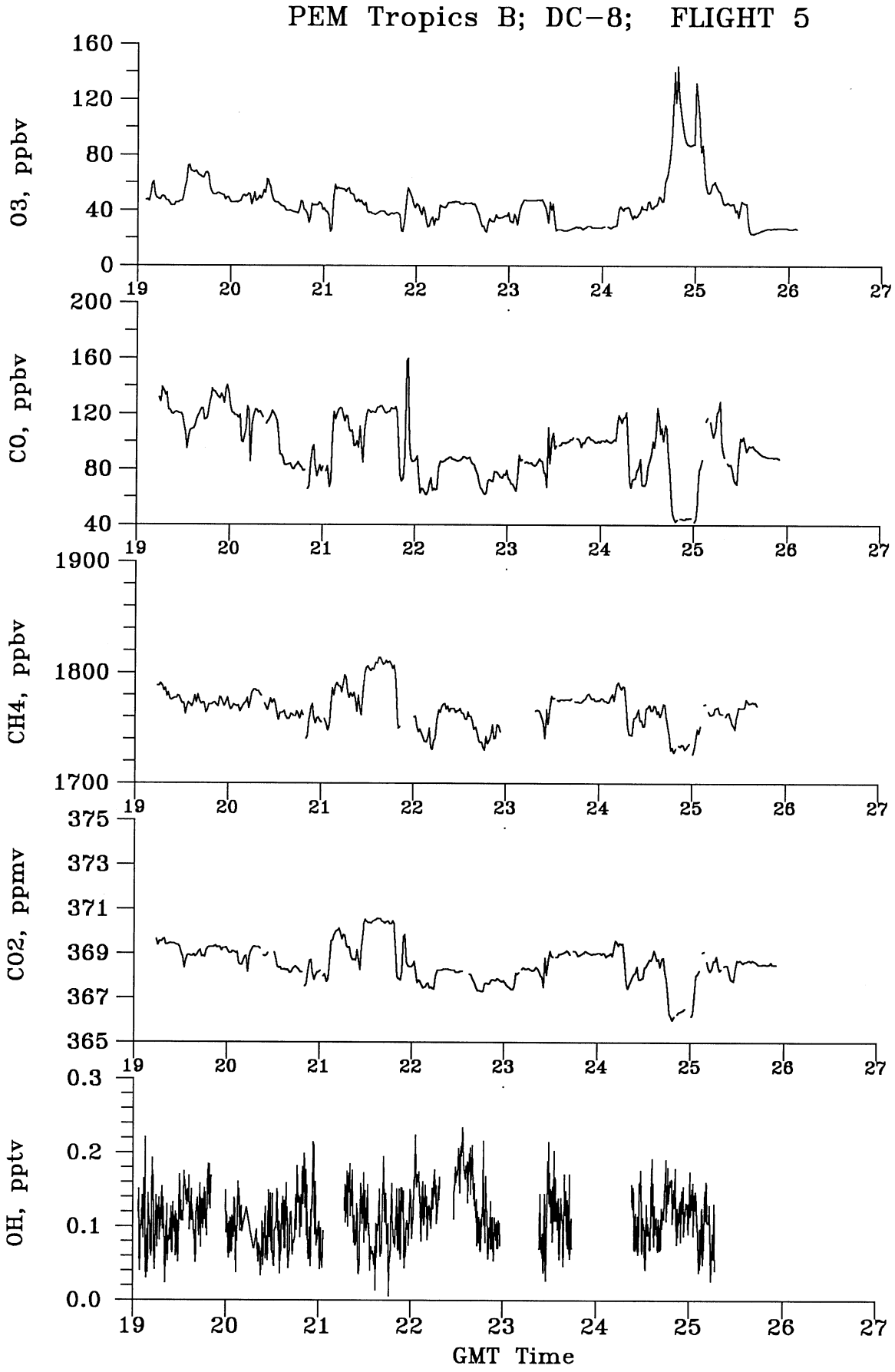
Flight 5D

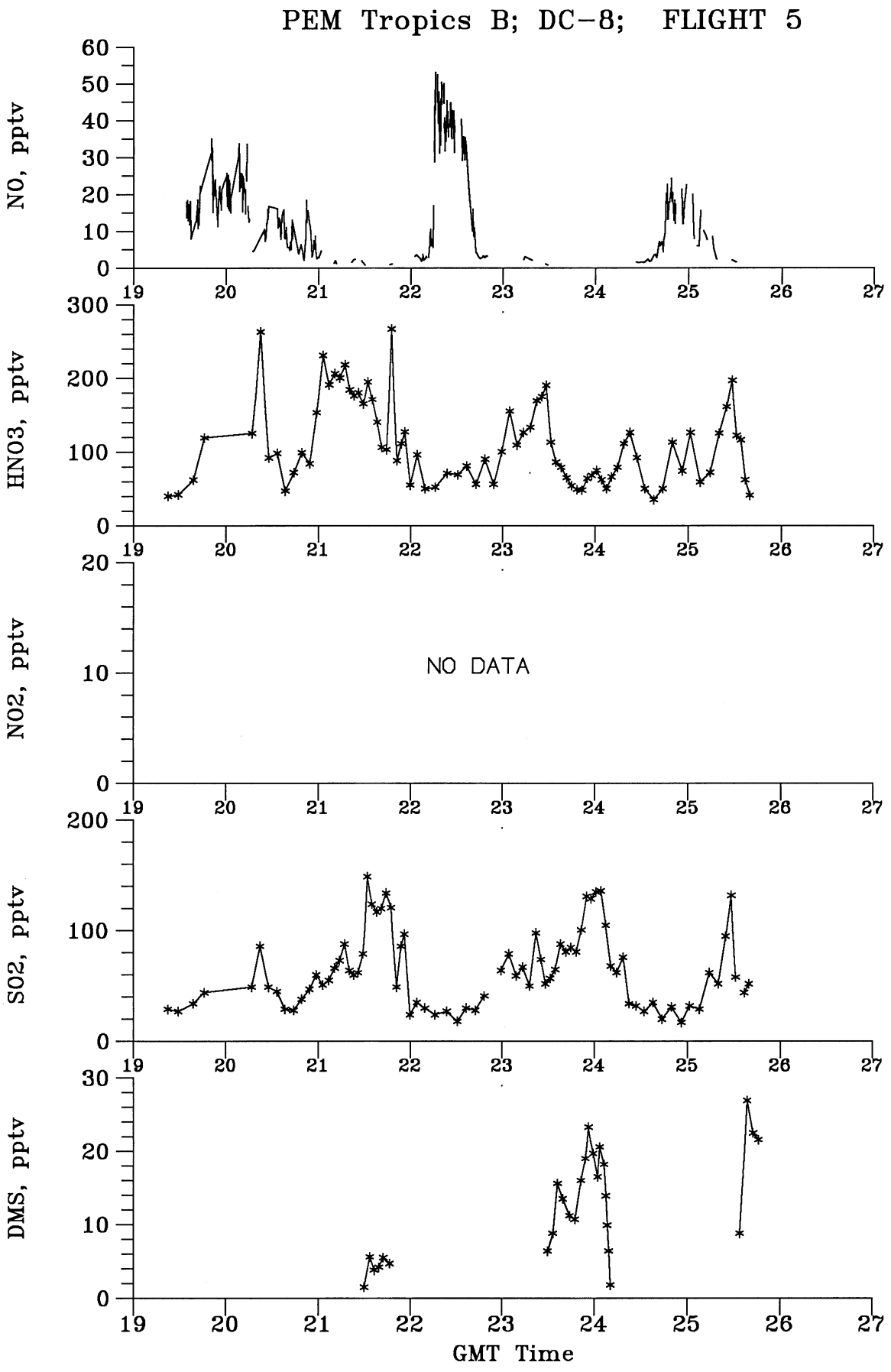
Transit: NASA DFRC to Hilo, HI

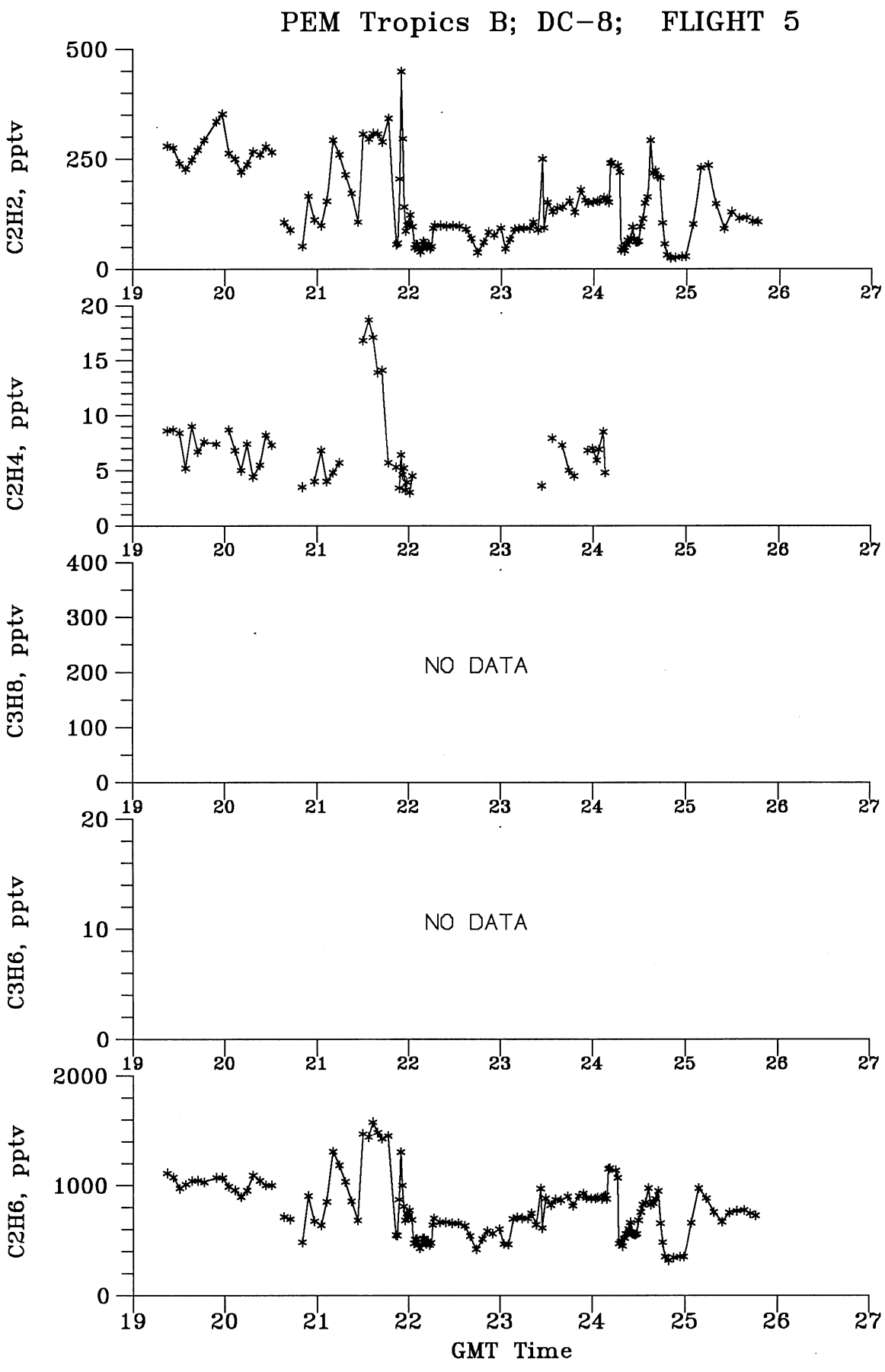
Northern Tropical Chemistry

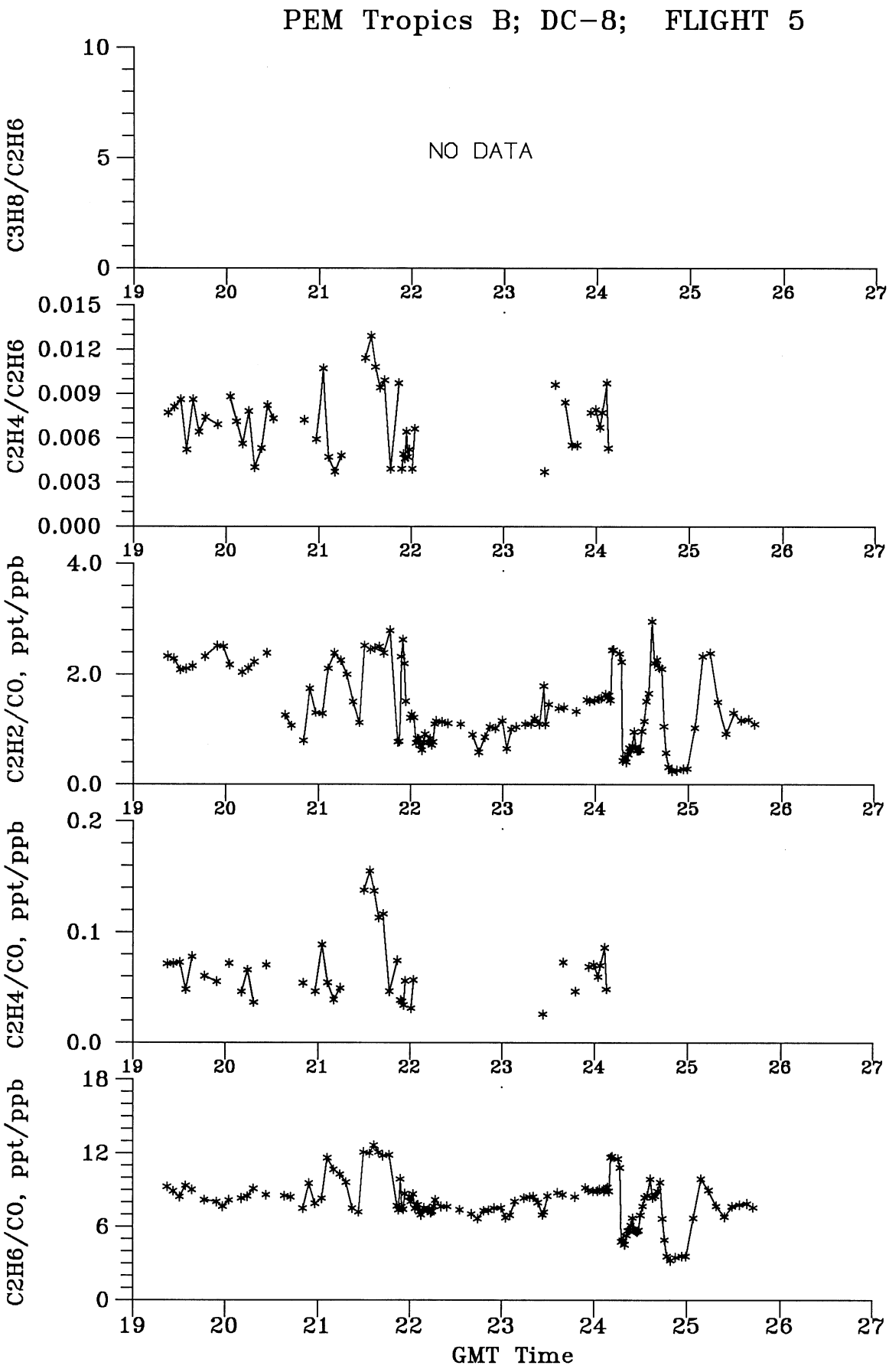
March 6, 1999

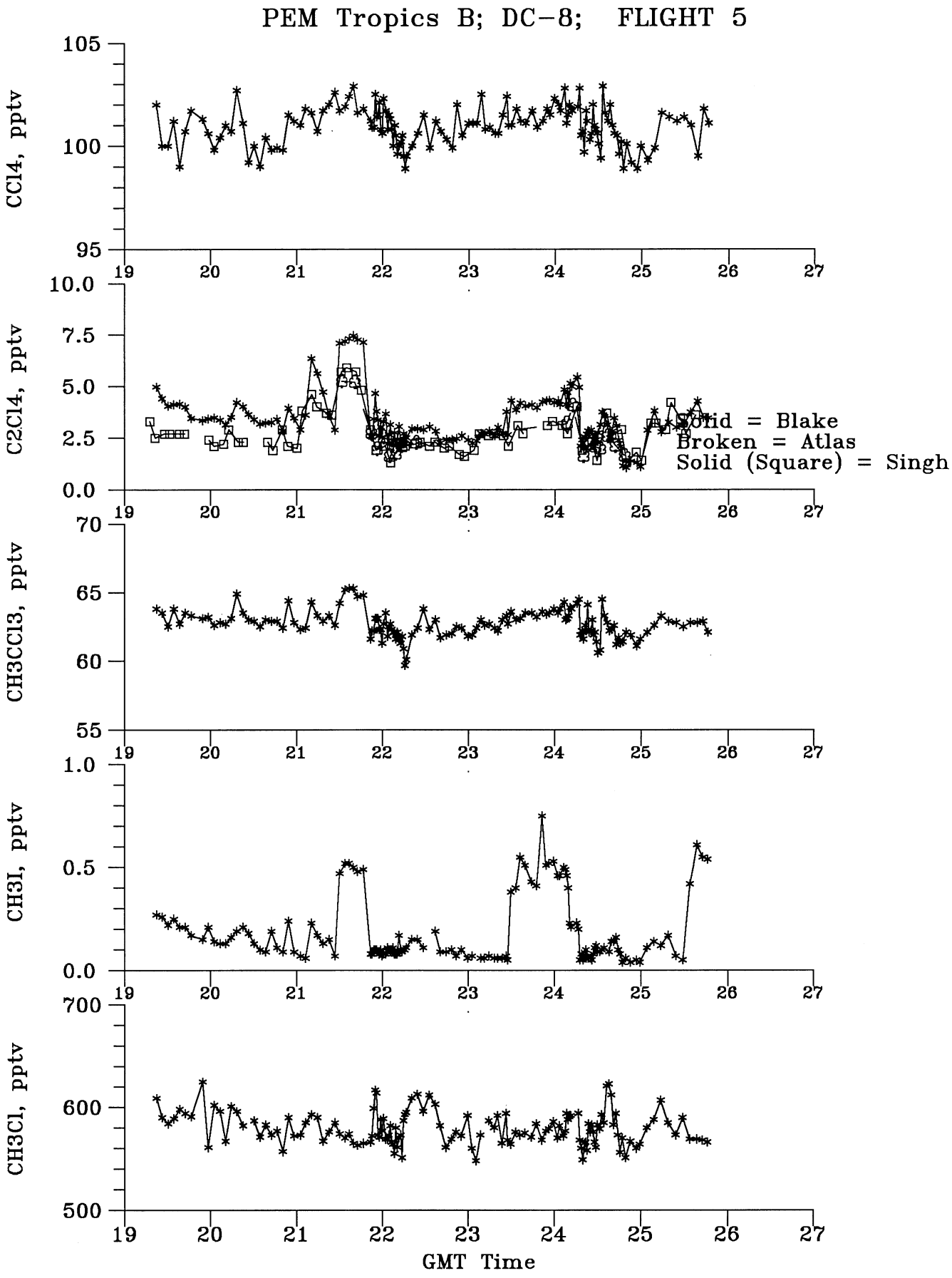

PEM Tropics B; DC-8; FLIGHT 5
North Latitude, deg.
40
30
20
10
205
210
215
220
225
230
235
240
245
East Longitude, deg.
Altitude, km
15
10
5
0
19
20
21
22
23
24
25
26
27
Temperature, C
40
20
0
-20
-40
-60
-80
Solid = Static Temp
Broken = Project Dew Pt.
Rel. Hum, percent
100
50
0
Water Vapor, ppm
20000
10000
0
NO DATA
GMT Time

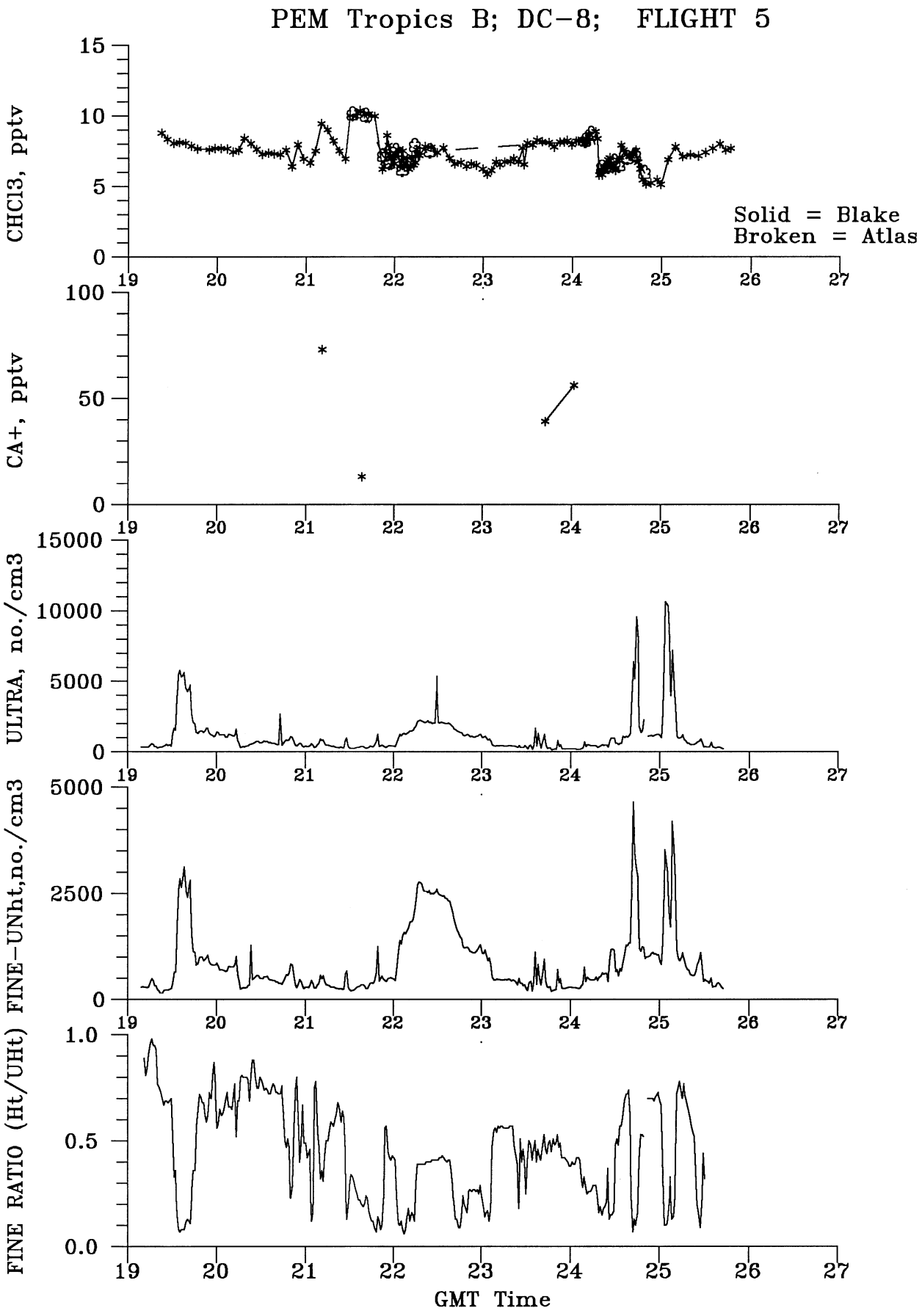

PEM Tropics B; DC-8; FLIGHT 5
O3, ppbv
160
120
80
40
0
CO, ppbv
200
160
120
80
40
CH4, ppbv
1900
1800
1700
CO2, ppmv
375
373
371
369
367
365
OH, pptv
0.3
0.2
0.1
0.0
19
20
21
22
23
24
25
26
27
GMT Time

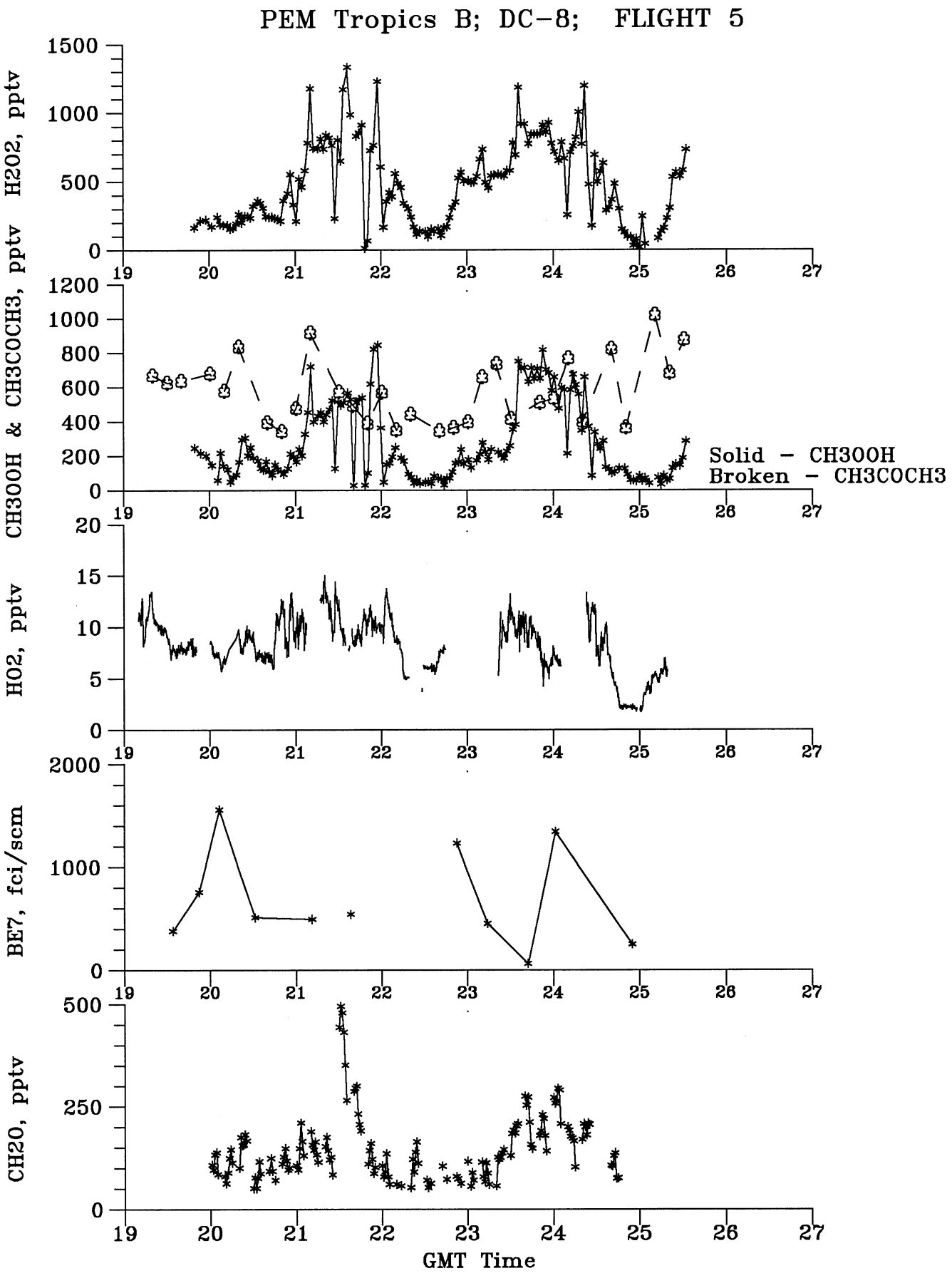

PEM Tropics B; DC-8; FLIGHT 5
NO, pptv
HNO3, pptv
NO2, pptv
NO DATA
SO2, pptv
DMS, pptv
GMT Time

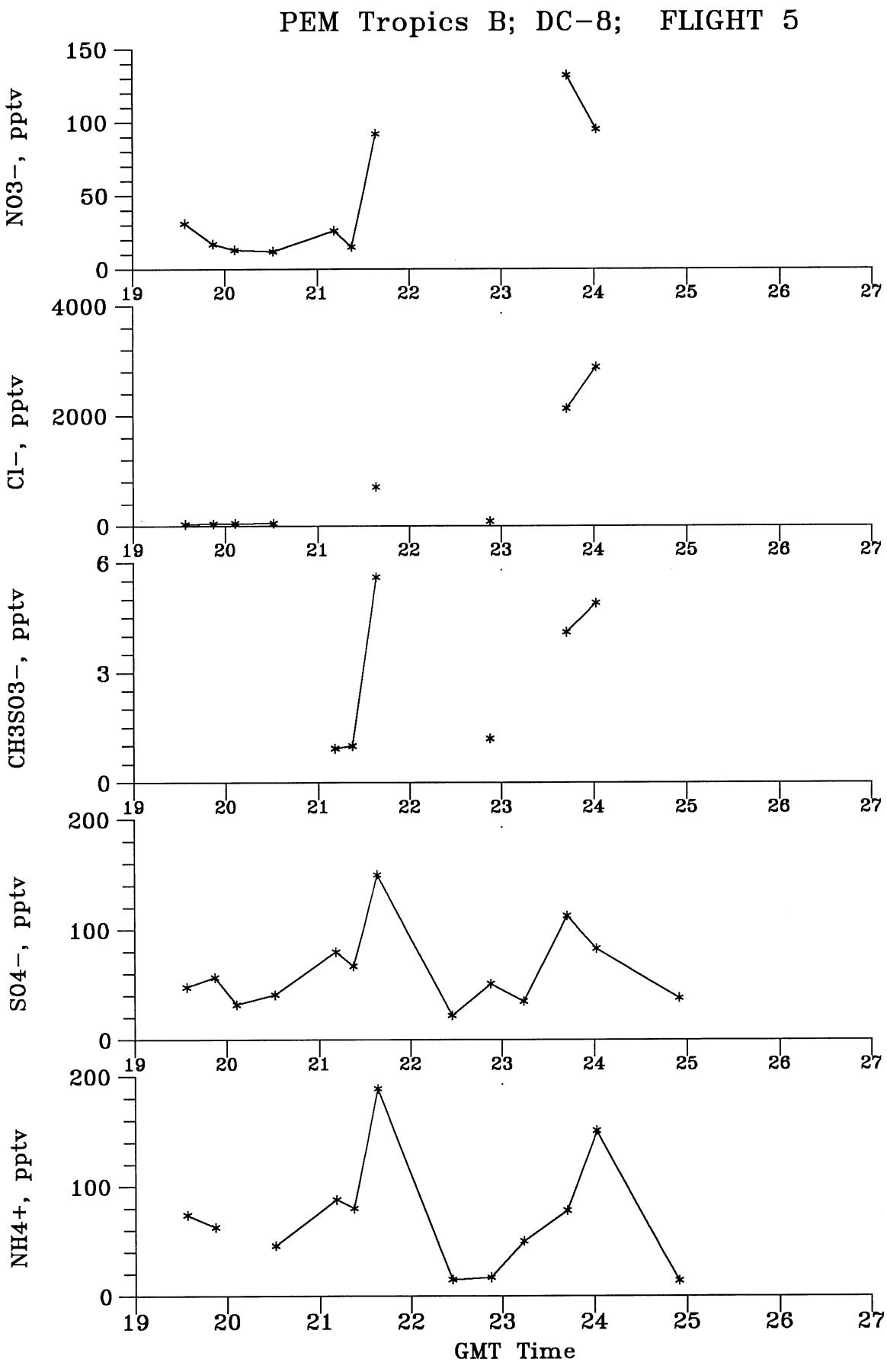

PEM Tropics B; DC-8; FLIGHT 5
C2H2, pptv
500
250
0
C2H4, pptv
20
15
10
5
0
C3H8, pptv
400
300
200
100
0
NO DATA
C3H6, pptv
20
10
0
NO DATA
C2H6, pptv
2000
1000
0
19
20
21
22
23
24
25
26
27
GMT Time

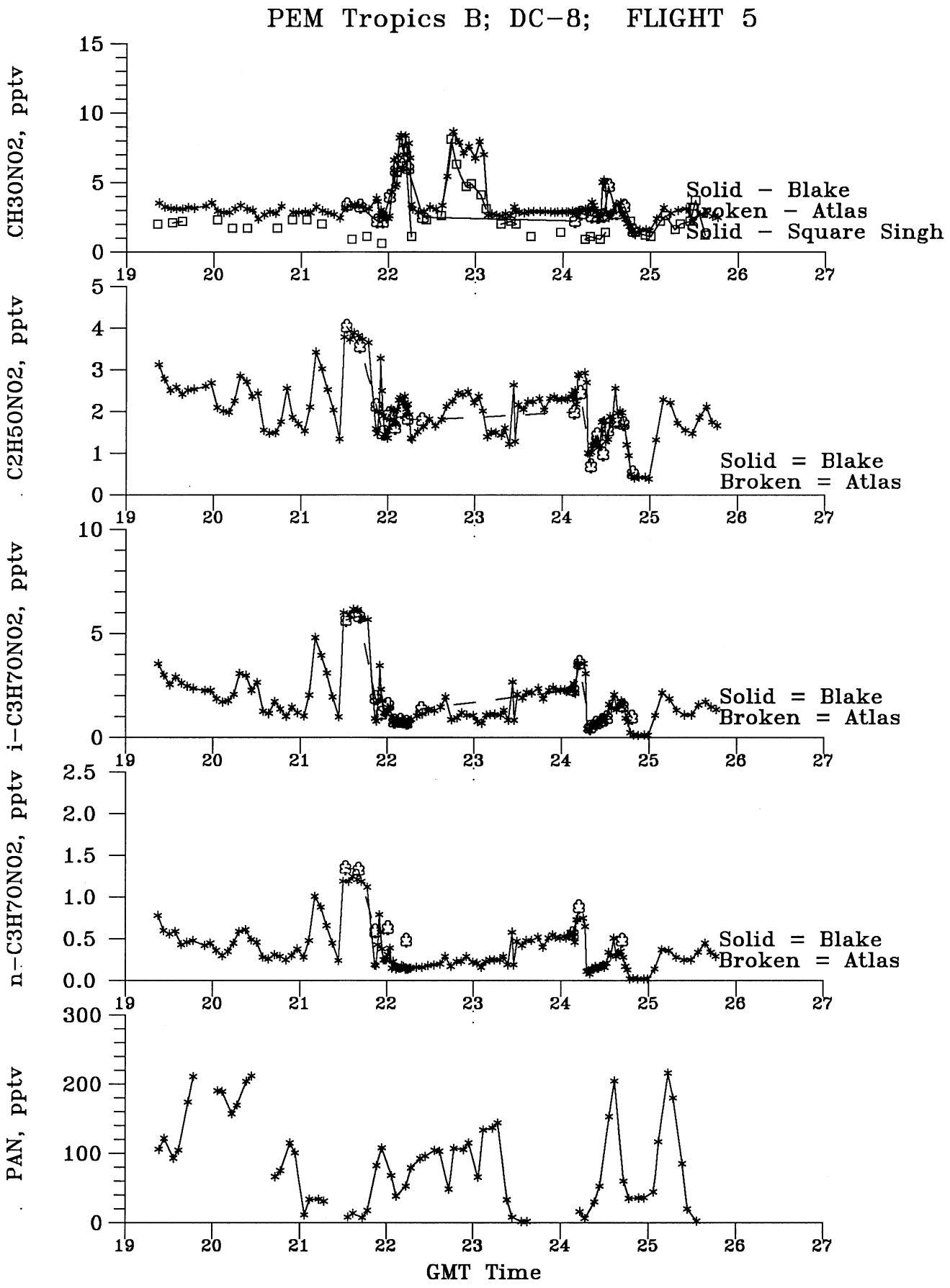

PEM Tropics B; DC-8; FLIGHT 5
C3H8/C2H6
NO DATA
C2H4/C2H6
C2H2/CO, ppt/ppb
C2H4/CO, ppt/ppb
C2H6/CO, ppt/ppb
GMT Time

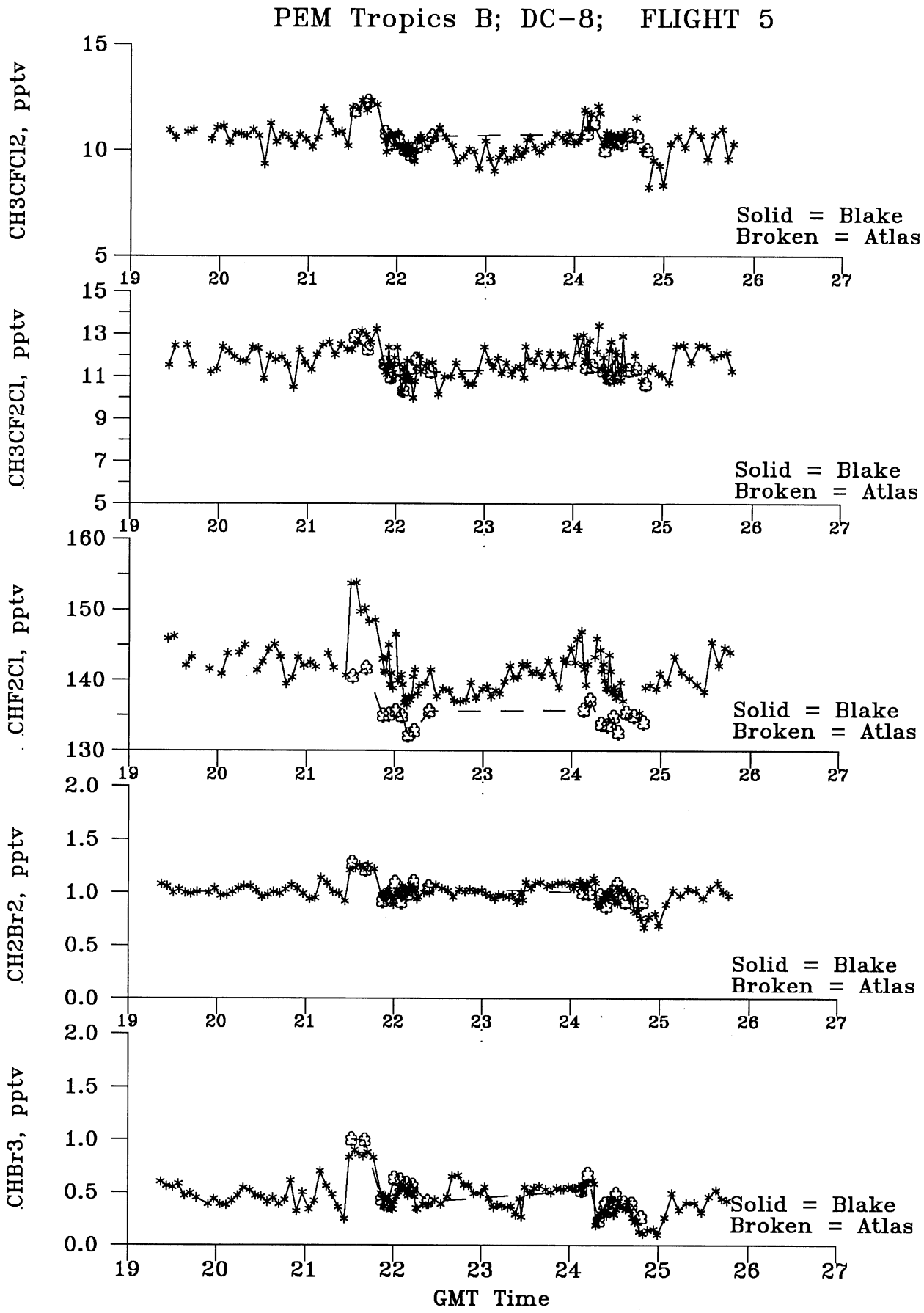

PEM Tropics B; DC-8; FLIGHT 5
CCl4, pptv
105
100
95
C2Cl4, pptv
10.0
7.5
5.0
2.5
0.0
Solid = Blake
Broken = Atlas
Solid (Square) = Singh
CH3CCl3, pptv
70
65
60
55
CH3I, pptv
1.0
0.5
0.0
CH3Cl, pptv
700
600
500
19
20
21
22
23
24
25
26
27
GMT Time

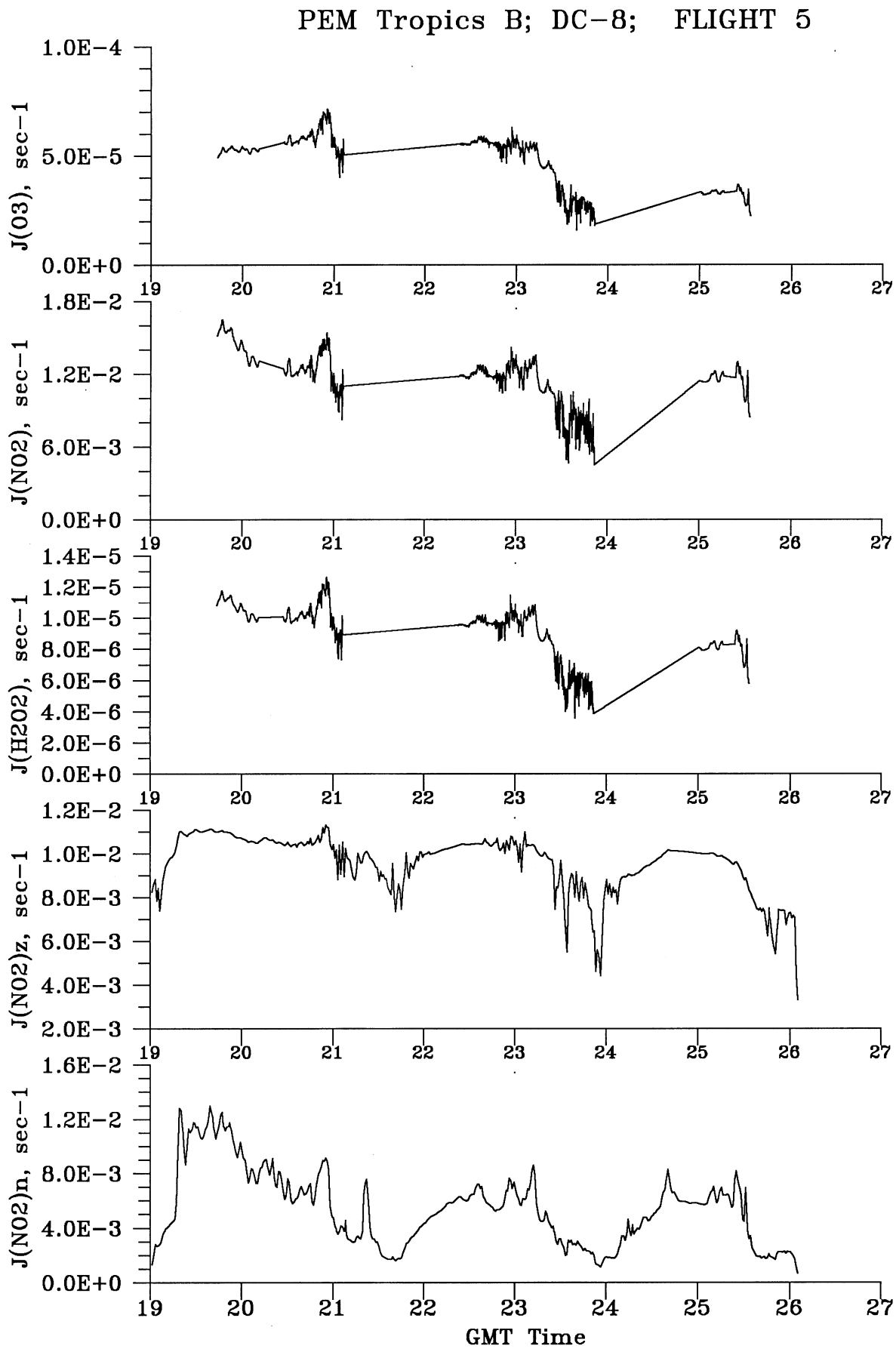

PEM Tropics B; DC-8; FLIGHT 5
CHCl3, pptv
Solid = Blake
Broken = Atlas
CA+, pptv
ULTRA, no./cm3
FINE-UNht,no./cm3
FINE RATIO (Ht/UHt)
GMT Time

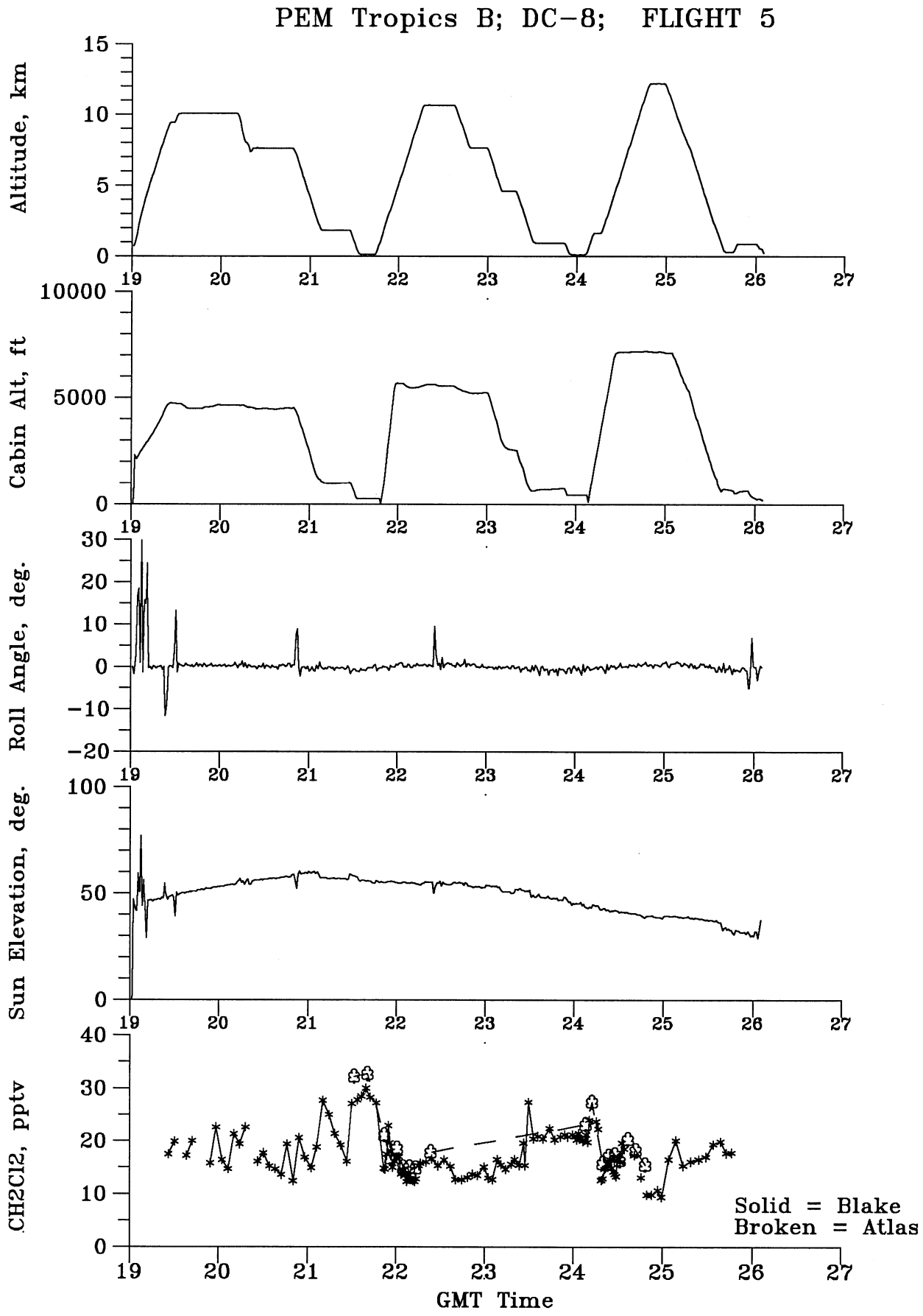

PEM Tropics B; DC-8; FLIGHT 5
H2O2, pptv
1500
1000
500
0
CH3OOH & CH3COCH3, pptv
1200
1000
800
600
400
200
0
Solid - CH3OOH
Broken - CH3COCH3
HO2, pptv
20
15
10
5
0
BE7, fci/scm
2000
1000
0
CH2O, pptv
500
250
0
19
20
21
22
23
24
25
26
27
GMT Time


PEM Tropics B; DC-8; FLIGHT 5
NO3-, pptv
150
100
50
0
Cl-, pptv
4000
2000
0
CH3SO3-, pptv
6
3
0
SO4-, pptv
200
100
0
NH4+, pptv
200
100
0
19
20
21
22
23
24
25
26
27
GMT Time

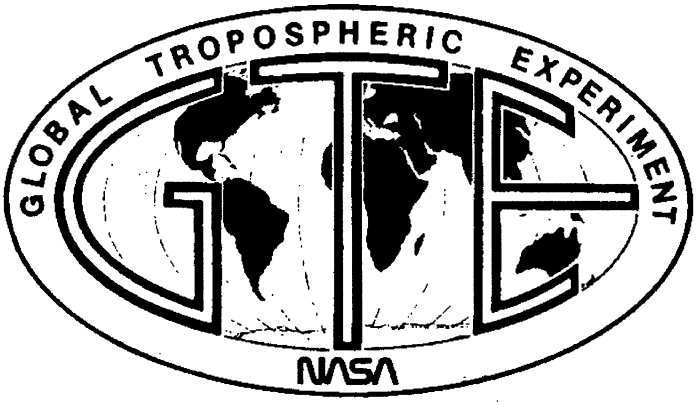

PEM Tropics B; DC-8; FLIGHT 5
CH3ONO2, pptv
Solid - Blake
Broken - Atlas
Solid - Square Singh
C2H5ONO2, pptv
Solid = Blake
Broken = Atlas
i-C3H7ONO2, pptv
Solid = Blake
Broken = Atlas
n-C3H7ONO2, pptv
Solid = Blake
Broken = Atlas
PAN, pptv
GMT Time


PEM Tropics B; DC-8; FLIGHT 5
CH3CFCl2, pptv
15
10
5
Solid = Blake
Broken = Atlas
CH3CF2Cl, pptv
15
13
11
9
7
5
Solid = Blake
Broken = Atlas
CHF2Cl, pptv
160
150
140
130
Solid = Blake
Broken = Atlas
CH2Br2, pptv
2.0
1.5
1.0
0.5
0.0
Solid = Blake
Broken = Atlas
CHBr3, pptv
2.0
1.5
1.0
0.5
0.0
Solid = Blake
Broken = Atlas
19
20
21
22
23
24
25
26
27
GMT Time


PEM Tropics B; DC-8; FLIGHT 5
J(O3), sec-1
1.0E-4
5.0E-5
0.0E+0
J(NO2), sec-1
1.8E-2
1.2E-2
6.0E-3
0.0E+0
J(H2O2), sec-1
1.4E-5
1.2E-5
1.0E-5
8.0E-6
6.0E-6
4.0E-6
2.0E-6
0.0E+0
J(NO2)z, sec-1
1.2E-2
1.0E-2
8.0E-3
6.0E-3
4.0E-3
2.0E-3
J(NO2)n, sec-1
1.6E-2
1.2E-2
8.0E-3
4.0E-3
0.0E+0
19
20
21
22
23
24
25
26
27
GMT Time


PEM Tropics B; DC-8; FLIGHT 5
Altitude, km
15
10
5
0
Cabin Alt, ft
10000
5000
0
Roll Angle, deg.
30
20
10
0
−10
−20
Sun Elevation, deg.
100
50
0
CH2Cl2, pptv
40
30
20
10
0
19
20
21
22
23
24
25
26
27
GMT Time
Solid = Blake
Broken = Atlas

PLOTS OF FINAL CHEMICAL DATA



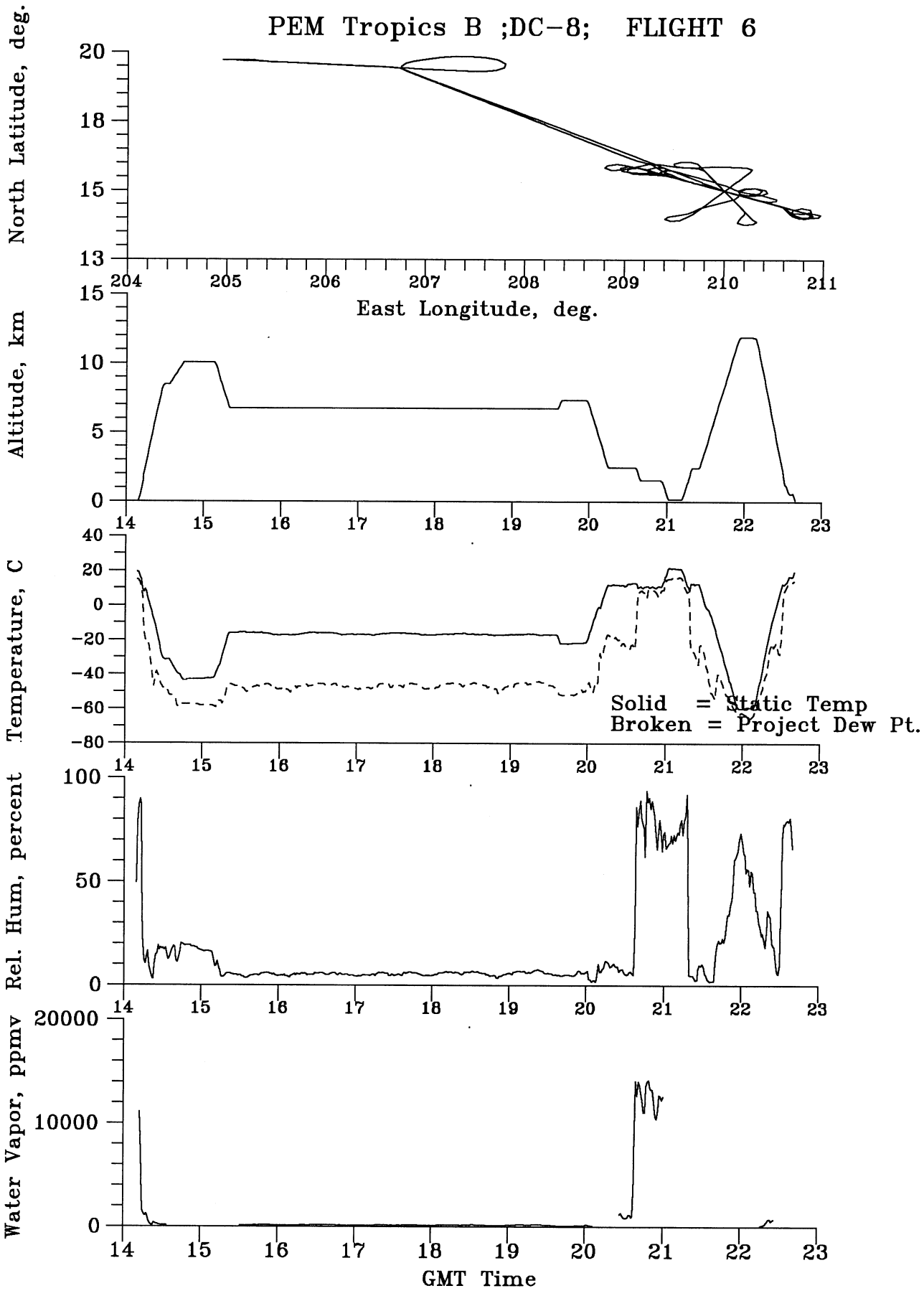
PEM-TROPICS B

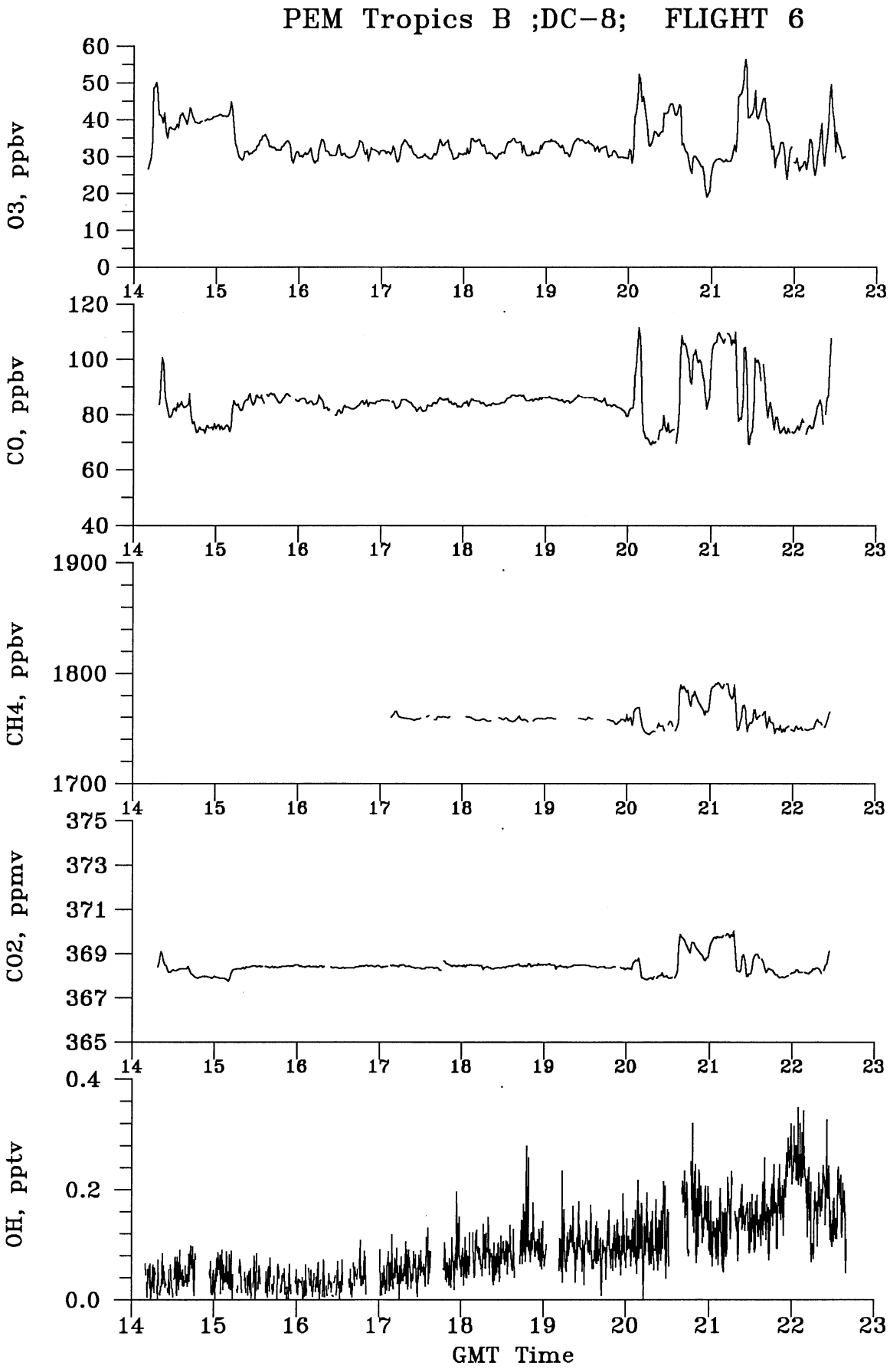
Flight 6D

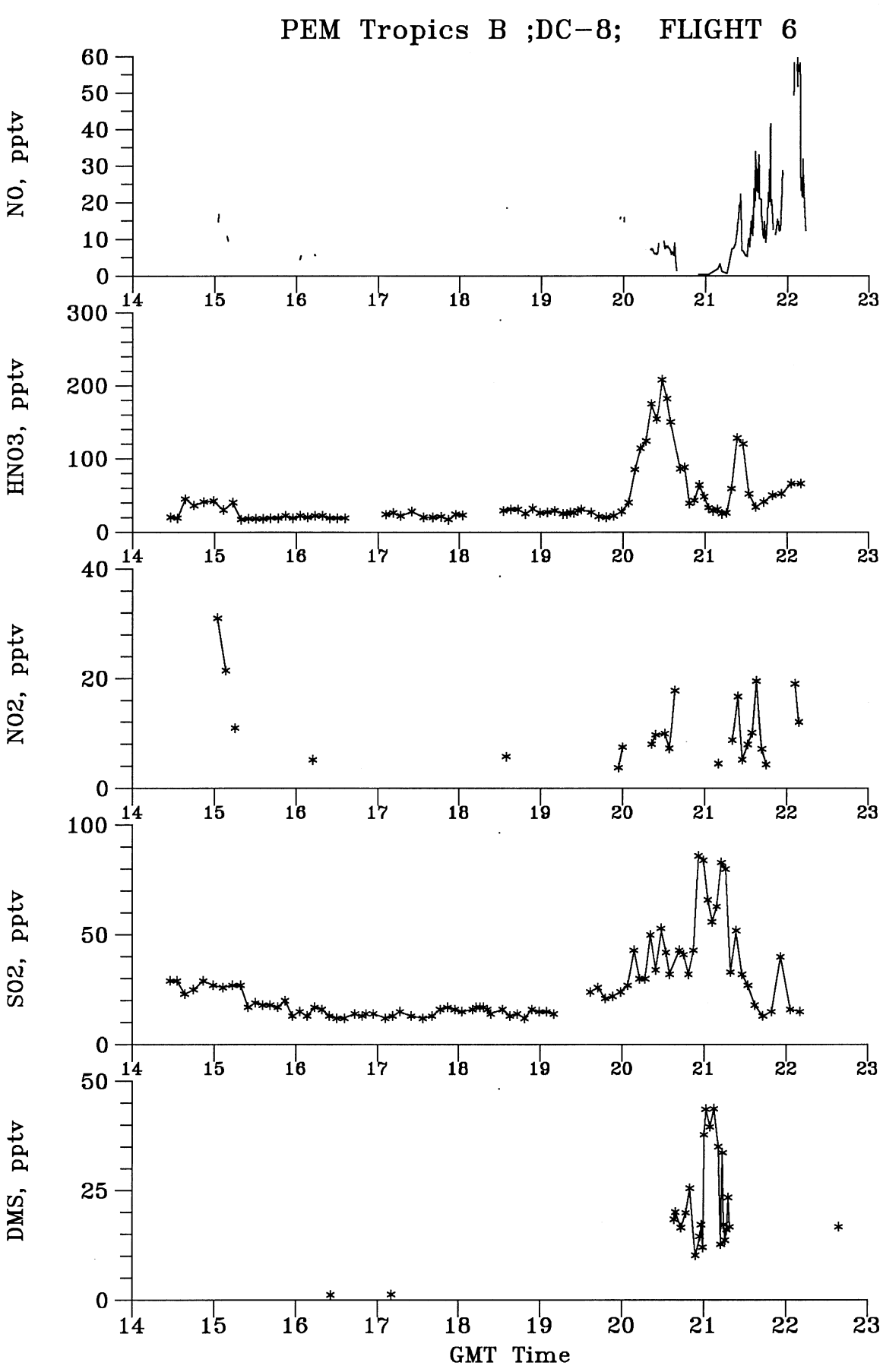
Local: Hilo No. 1

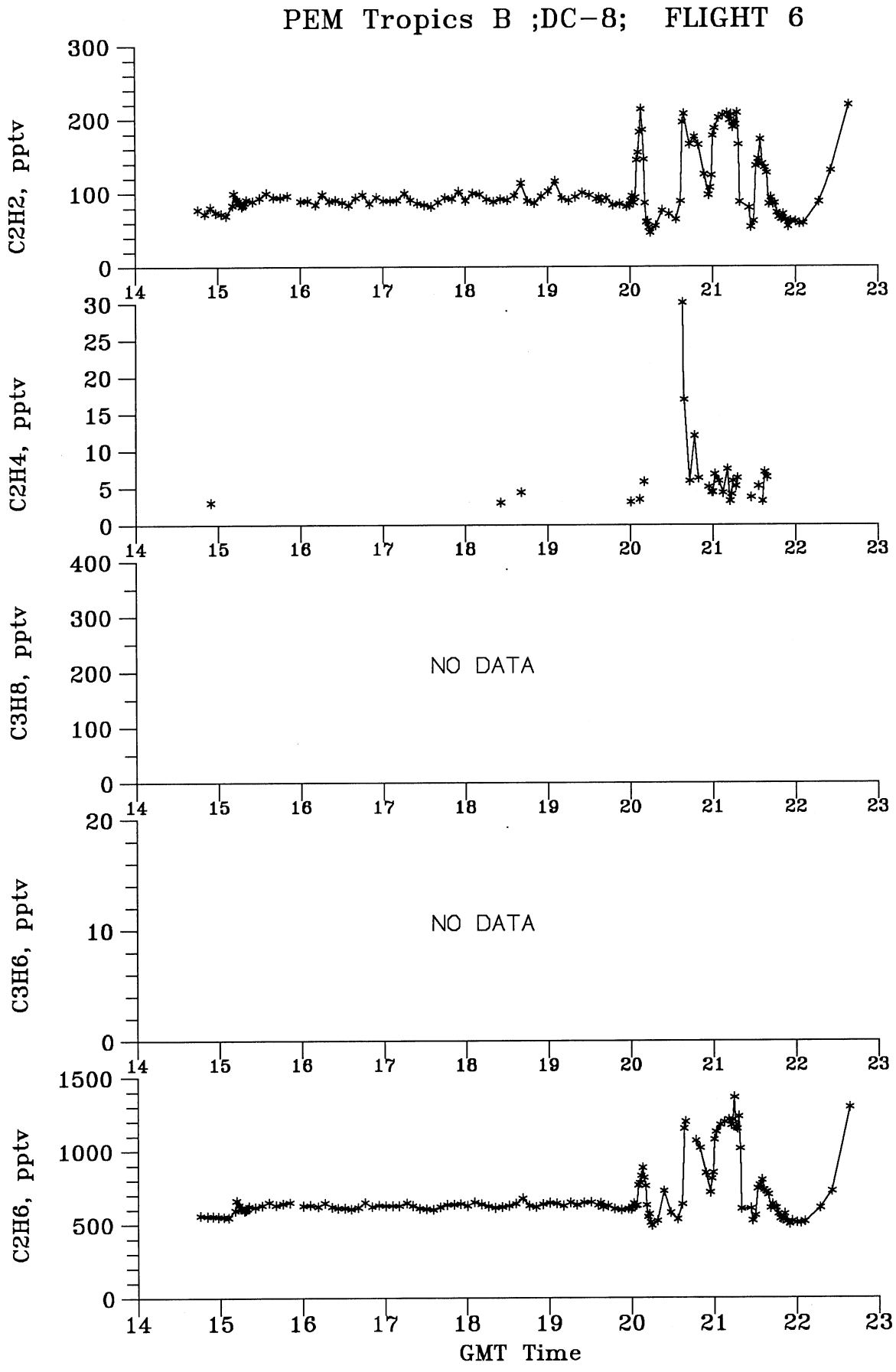
Sunrise Photochemistry

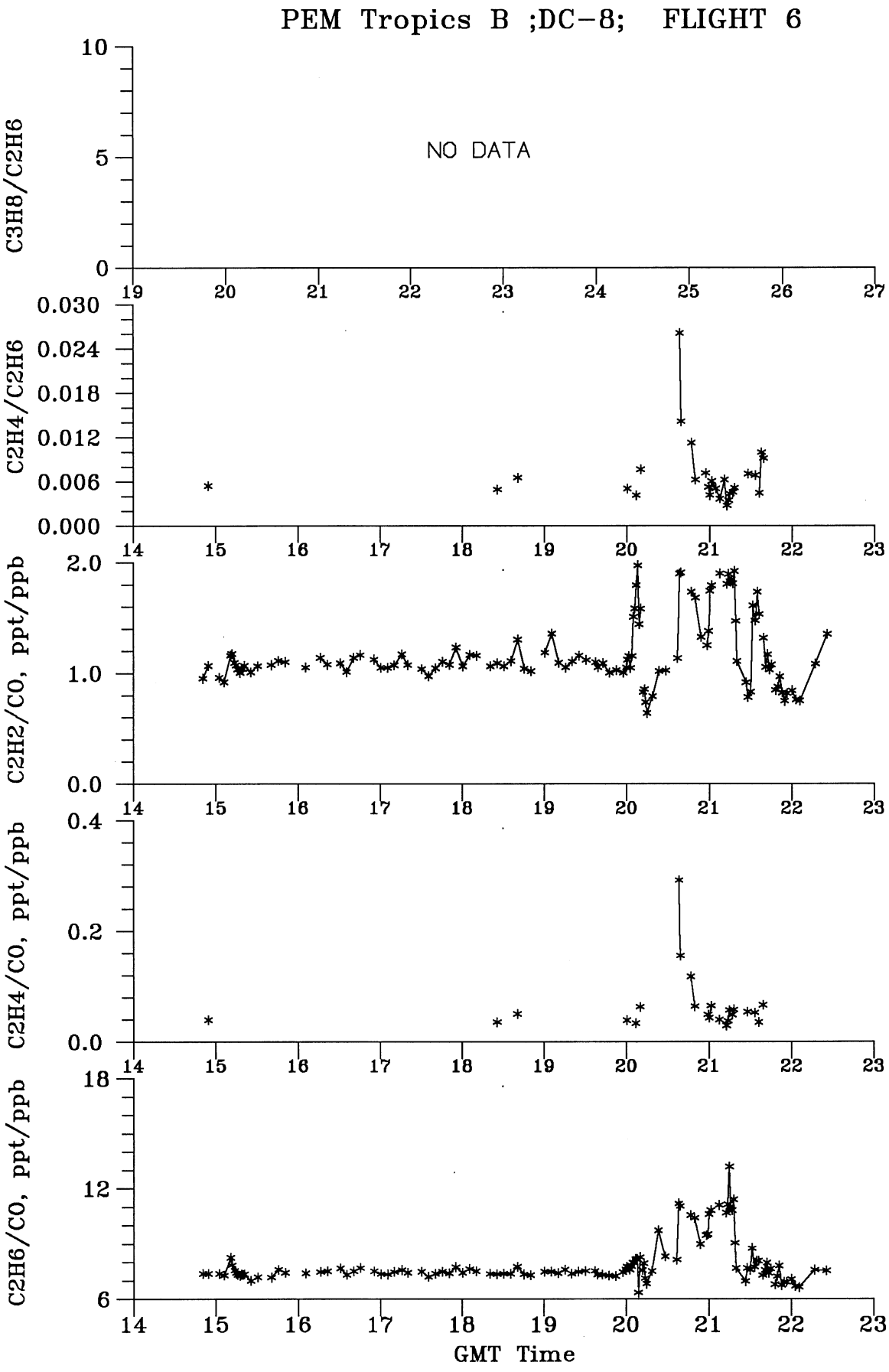
March 9, 1999

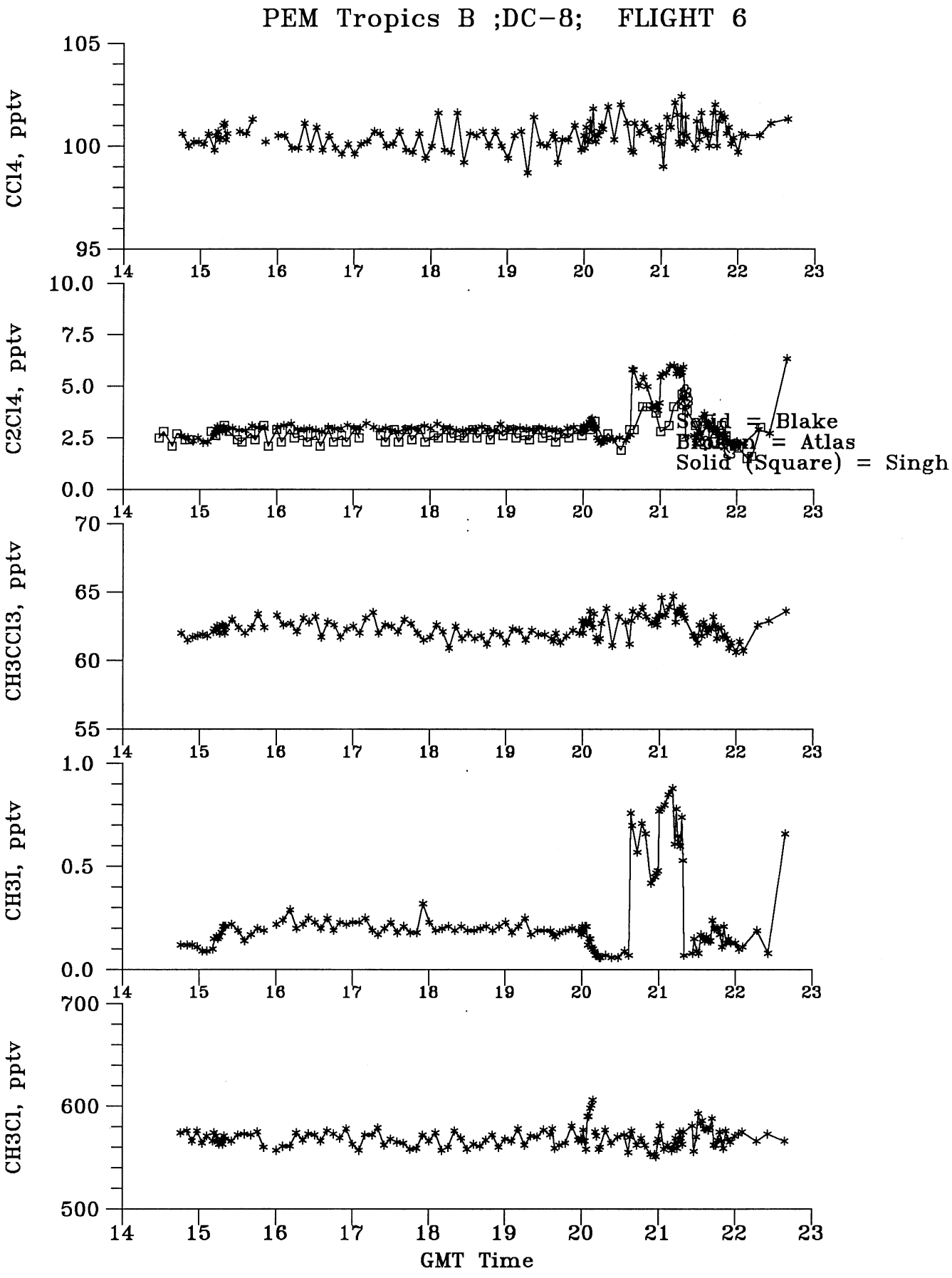

PEM Tropics B ;DC-8; FLIGHT 6
North Latitude, deg.
20
18
15
13
204
205
206
207
208
209
210
211
East Longitude, deg.
Altitude, km
15
10
5
0
14
15
16
17
18
19
20
21
22
23
Temperature, C
40
20
0
-20
-40
-60
-80
Solid = Static Temp
Broken = Project Dew Pt.
Rel. Hum, percent
100
50
0
Water Vapor, ppmv
20000
10000
0
GMT Time

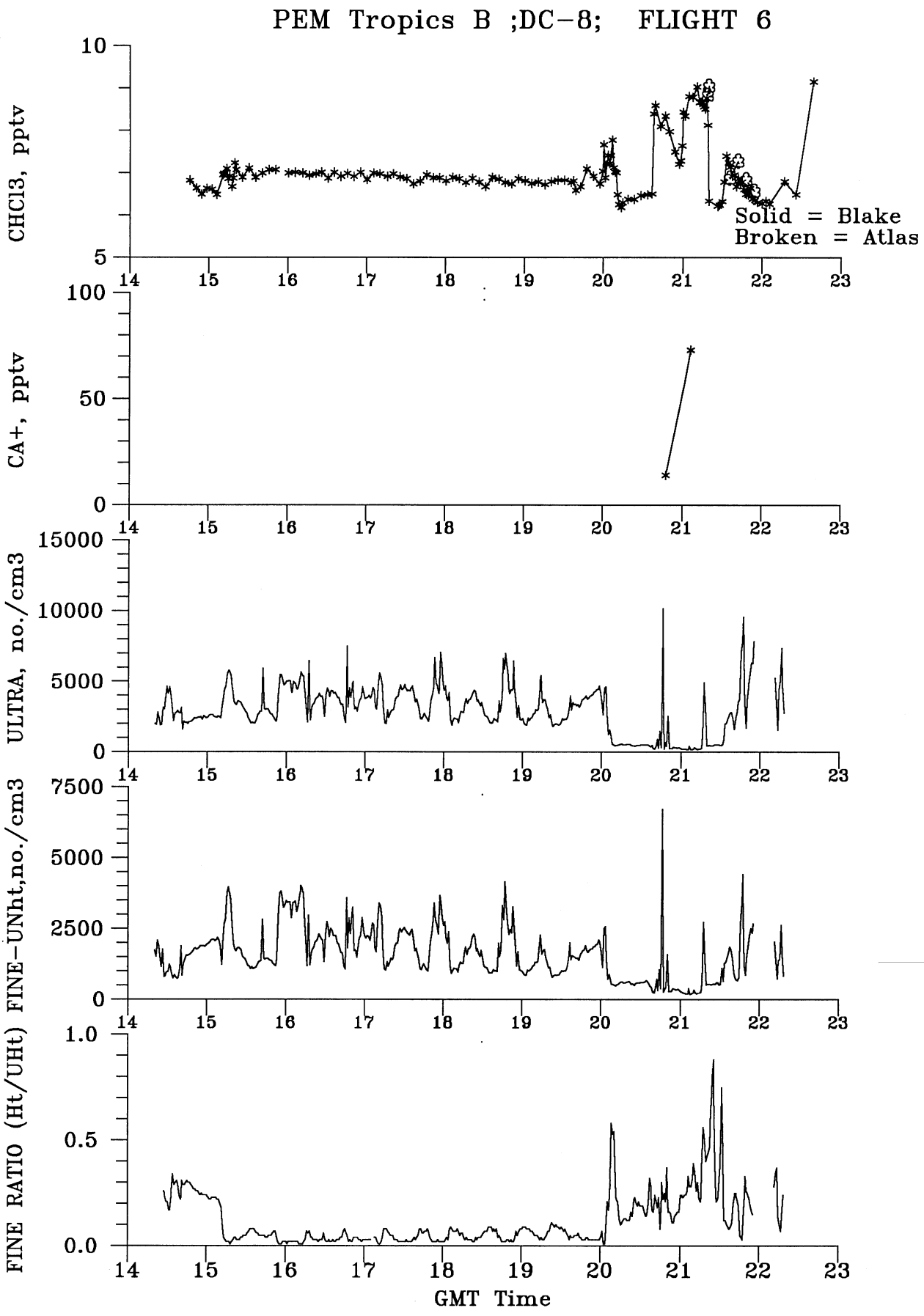

PEM Tropics B ;DC-8; FLIGHT 6
O3, ppbv
60
50
40
30
20
10
0
CO, ppbv
120
100
80
60
40
CH4, ppbv
1900
1800
1700
CO2, ppmv
375
373
371
369
367
365
OH, pptv
0.4
0.2
0.0
14
15
16
17
18
19
20
21
22
23
GMT Time

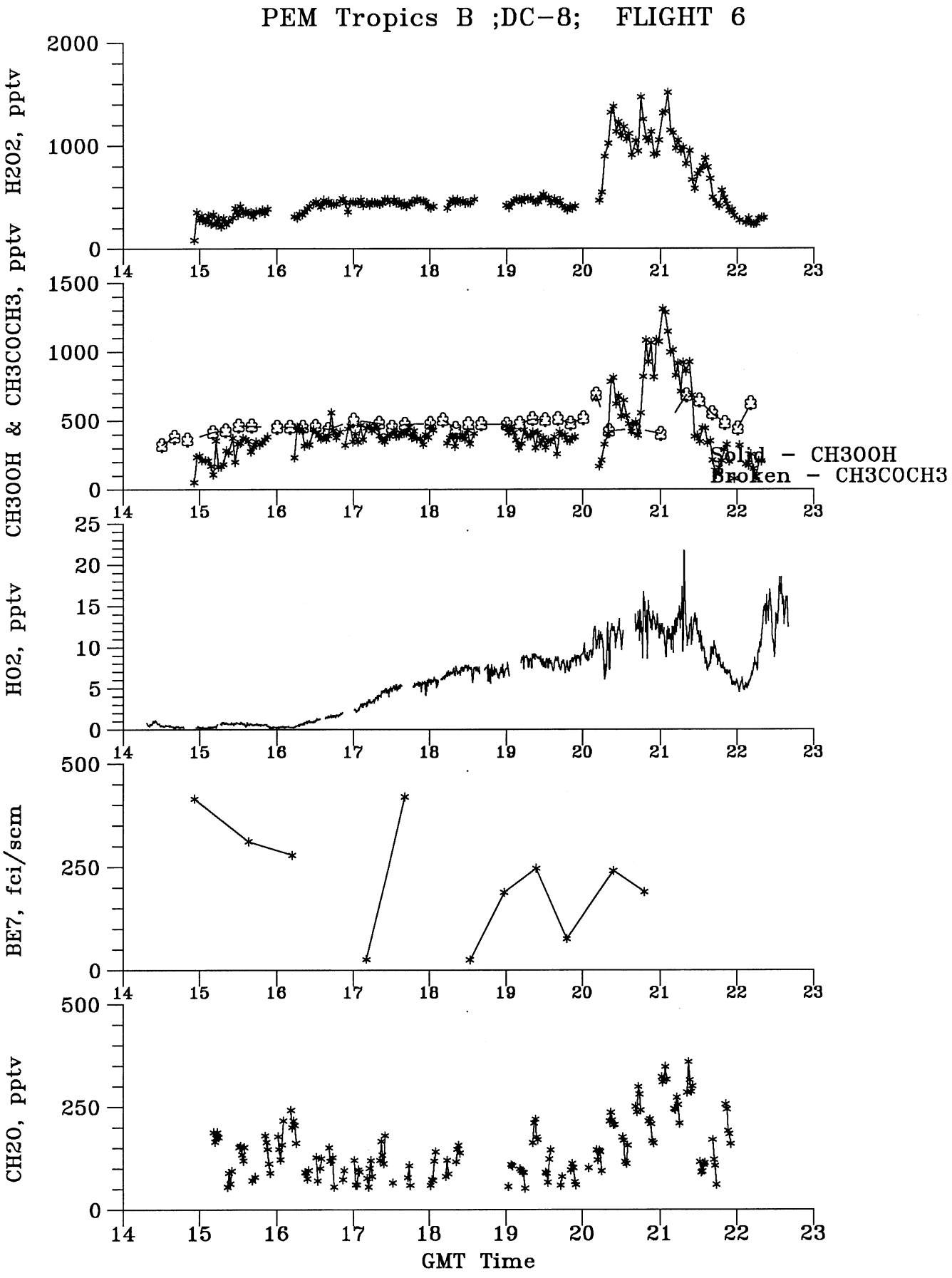

PEM Tropics B ;DC-8; FLIGHT 6
NO, pptv
HNO3, pptv
NO2, pptv
SO2, pptv
DMS, pptv
GMT Time

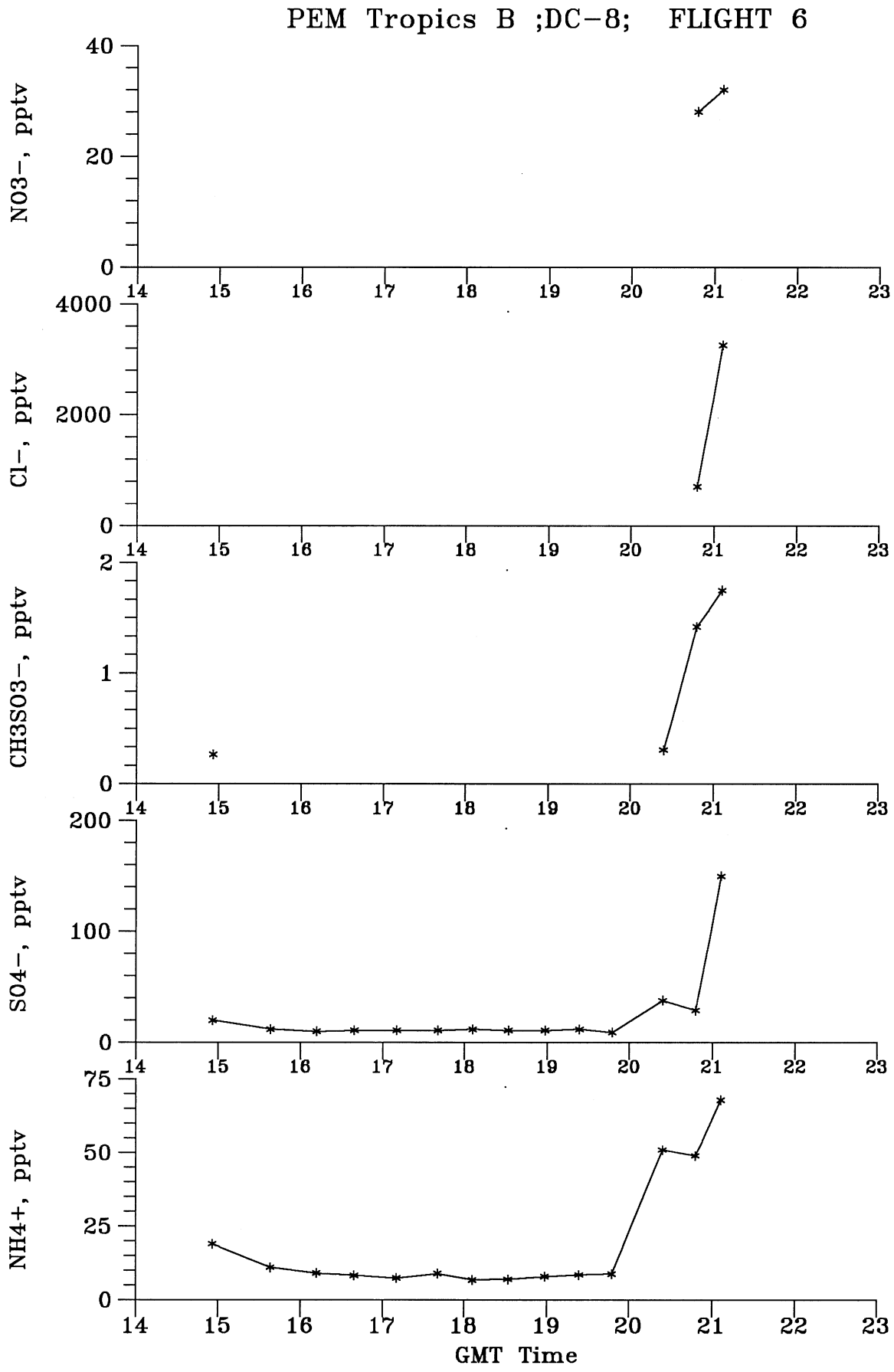

PEM Tropics B ;DC-8; FLIGHT 6
C2H2, pptv
300
200
100
0
C2H4, pptv
30
25
20
15
10
5
0
C3H8, pptv
400
300
200
100
0
NO DATA
C3H6, pptv
20
10
0
NO DATA
C2H6, pptv
1500
1000
500
0
14
15
16
17
18
19
20
21
22
23
GMT Time

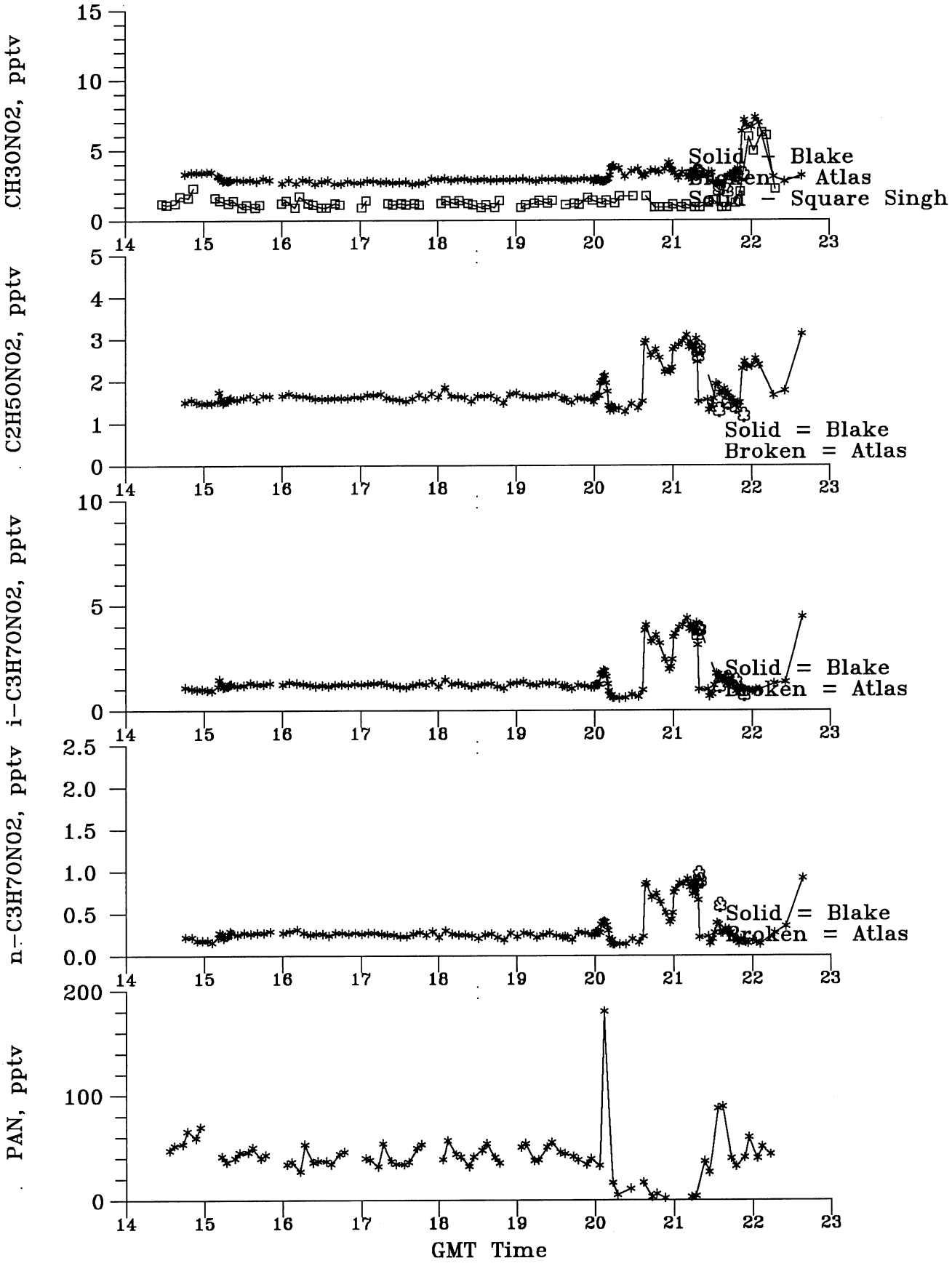

PEM Tropics B ;DC-8; FLIGHT 6
C3H8/C2H6
NO DATA
C2H4/C2H6
C2H2/CO, ppt/ppb
C2H4/CO, ppt/ppb
C2H6/CO, ppt/ppb
GMT Time

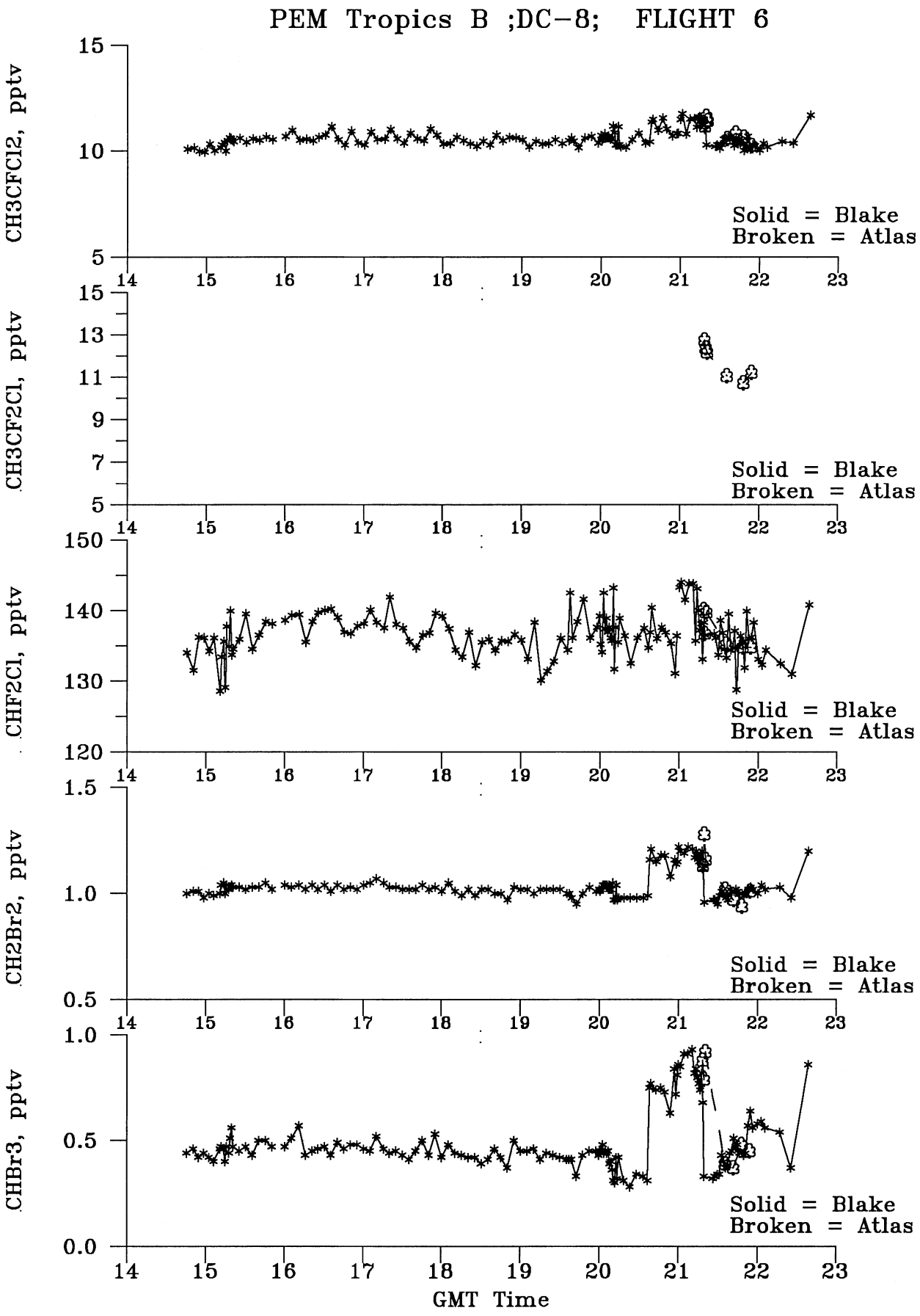

PEM Tropics B ;DC-8; FLIGHT 6
CCl4, pptv
105
100
95
C2Cl4, pptv
10.0
7.5
5.0
2.5
0.0
Solid = Blake
= Atlas
Solid (Square) = Singh
CH3CCl3, pptv
70
65
60
55
CH3I, pptv
1.0
0.5
0.0
CH3Cl, pptv
700
600
500
14
15
16
17
18
19
20
21
22
23
GMT Time

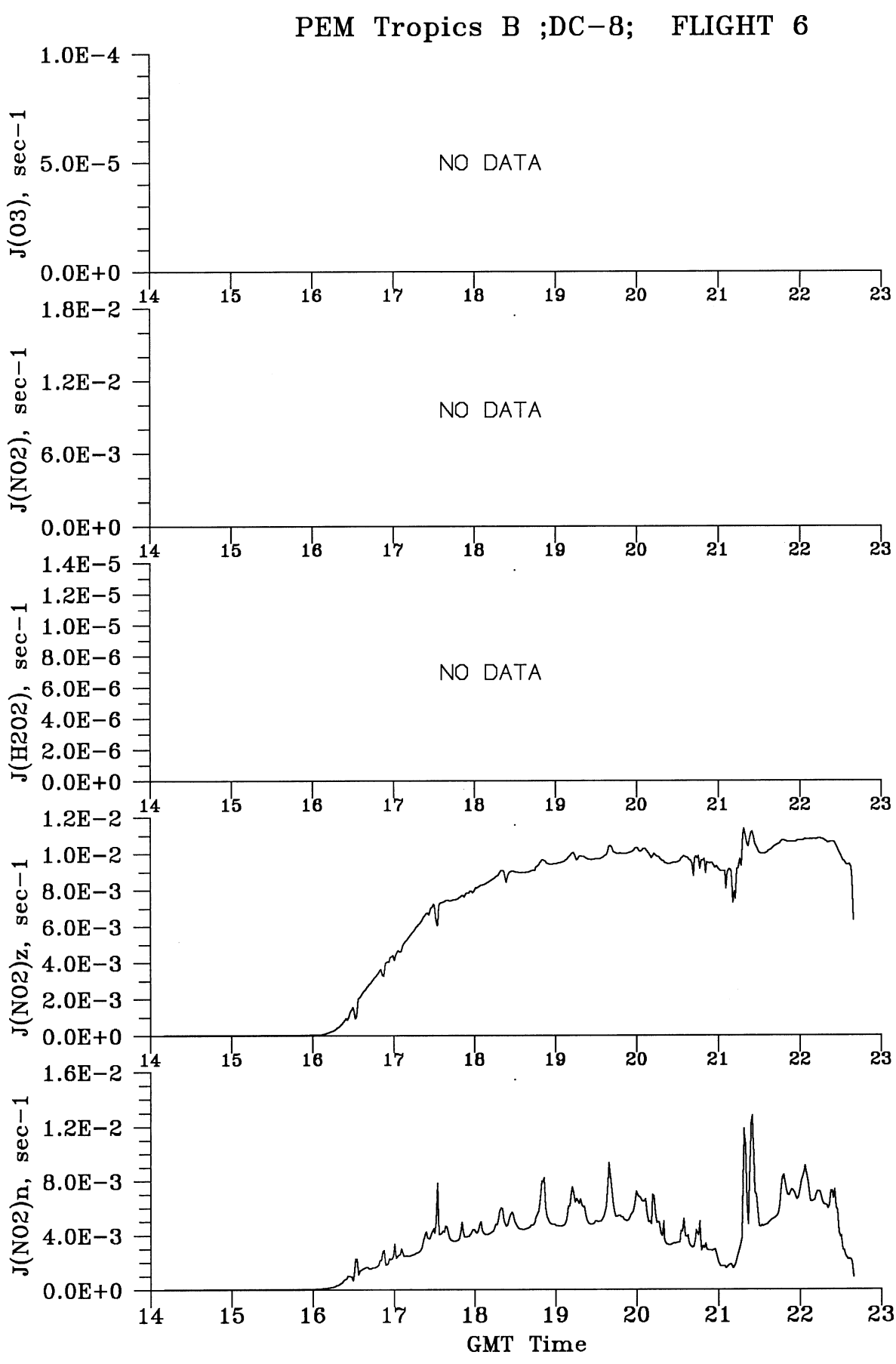

PEM Tropics B ;DC-8; FLIGHT 6
CHCl3, pptv
10
5
Solid = Blake
Broken = Atlas
CA+, pptv
100
50
0
ULTRA, no./cm3
15000
10000
5000
0
FINE-UNht,no./cm3
7500
5000
2500
0
FINE RATIO (Ht/UHt)
1.0
0.5
0.0
14
15
16
17
18
19
20
21
22
23
GMT Time

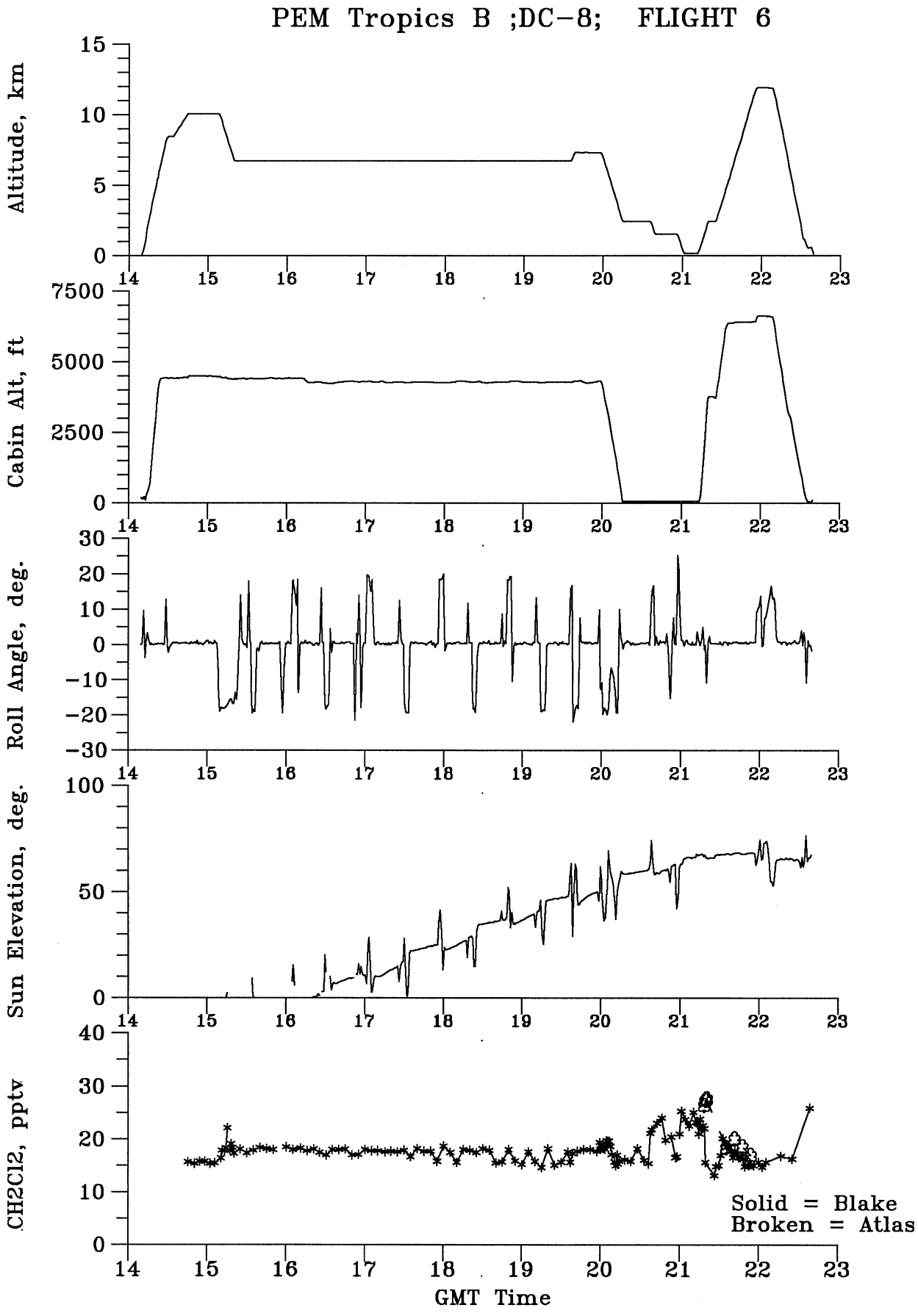

PEM Tropics B ;DC-8; FLIGHT 6
H2O2, pptv
2000
1000
0
CH3OOH & CH3COCH3, pptv
1500
1000
500
0
Solid - CH3OOH
Broken - CH3COCH3
HO2, pptv
25
20
15
10
5
0
BE7, fci/scm
500
250
0
CH2O, pptv
500
250
0
14
15
16
17
18
19
20
21
22
23
GMT Time


PEM Tropics B ;DC-8; FLIGHT 6
NO3-, pptv
40
20
0
Cl-, pptv
4000
2000
0
CH3SO3-, pptv
2
1
0
SO4-, pptv
200
100
0
NH4+, pptv
75
50
25
0
14
15
16
17
18
19
20
21
22
23
GMT Time

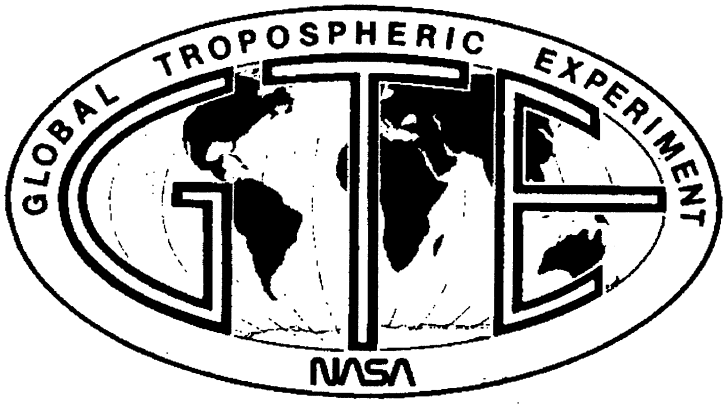

PEM Tropics B ;DC-8; FLIGHT 6
CH3ONO2, pptv
Solid = Blake
Broken = Atlas
Solid = Square Singh
C2H5ONO2, pptv
Solid = Blake
Broken = Atlas
i-C3H7ONO2, pptv
n-C3H7ONO2, pptv
Solid = Blake
Broken = Atlas
PAN, pptv
Solid = Blake
Broken = Atlas
GMT Time


PEM Tropics B ;DC-8; FLIGHT 6
CH3CFCl2, pptv
15
10
5
Solid = Blake
Broken = Atlas
CH3CF2Cl, pptv
15
13
11
9
7
5
Solid = Blake
Broken = Atlas
CHF2Cl, pptv
150
140
130
120
Solid = Blake
Broken = Atlas
CH2Br2, pptv
1.5
1.0
0.5
Solid = Blake
Broken = Atlas
CHBr3, pptv
1.0
0.5
0.0
Solid = Blake
Broken = Atlas
14
15
16
17
18
19
20
21
22
23
GMT Time


PEM Tropics B ;DC-8; FLIGHT 6
J(O3), sec-1
1.0E-4
5.0E-5
0.0E+0
NO DATA
J(NO2), sec-1
1.8E-2
1.2E-2
6.0E-3
0.0E+0
NO DATA
J(H2O2), sec-1
1.4E-5
1.2E-5
1.0E-5
8.0E-6
6.0E-6
4.0E-6
2.0E-6
0.0E+0
NO DATA
J(NO2)z, sec-1
1.2E-2
1.0E-2
8.0E-3
6.0E-3
4.0E-3
2.0E-3
0.0E+0
J(NO2)n, sec-1
1.6E-2
1.2E-2
8.0E-3
4.0E-3
0.0E+0
14 15 16 17 18 19 20 21 22 23
GMT Time


PEM Tropics B ;DC-8; FLIGHT 6
Altitude, km
15
10
5
0
Cabin Alt, ft
7500
5000
2500
0
Roll Angle, deg.
30
20
10
0
−10
−20
−30
Sun Elevation, deg.
100
50
0
CH2Cl2, pptv
40
30
20
10
0
14
15
16
17
18
19
20
21
22
23
GMT Time
Solid = Blake
Broken = Atlas

PLOTS OF FINAL CHEMICAL DATA



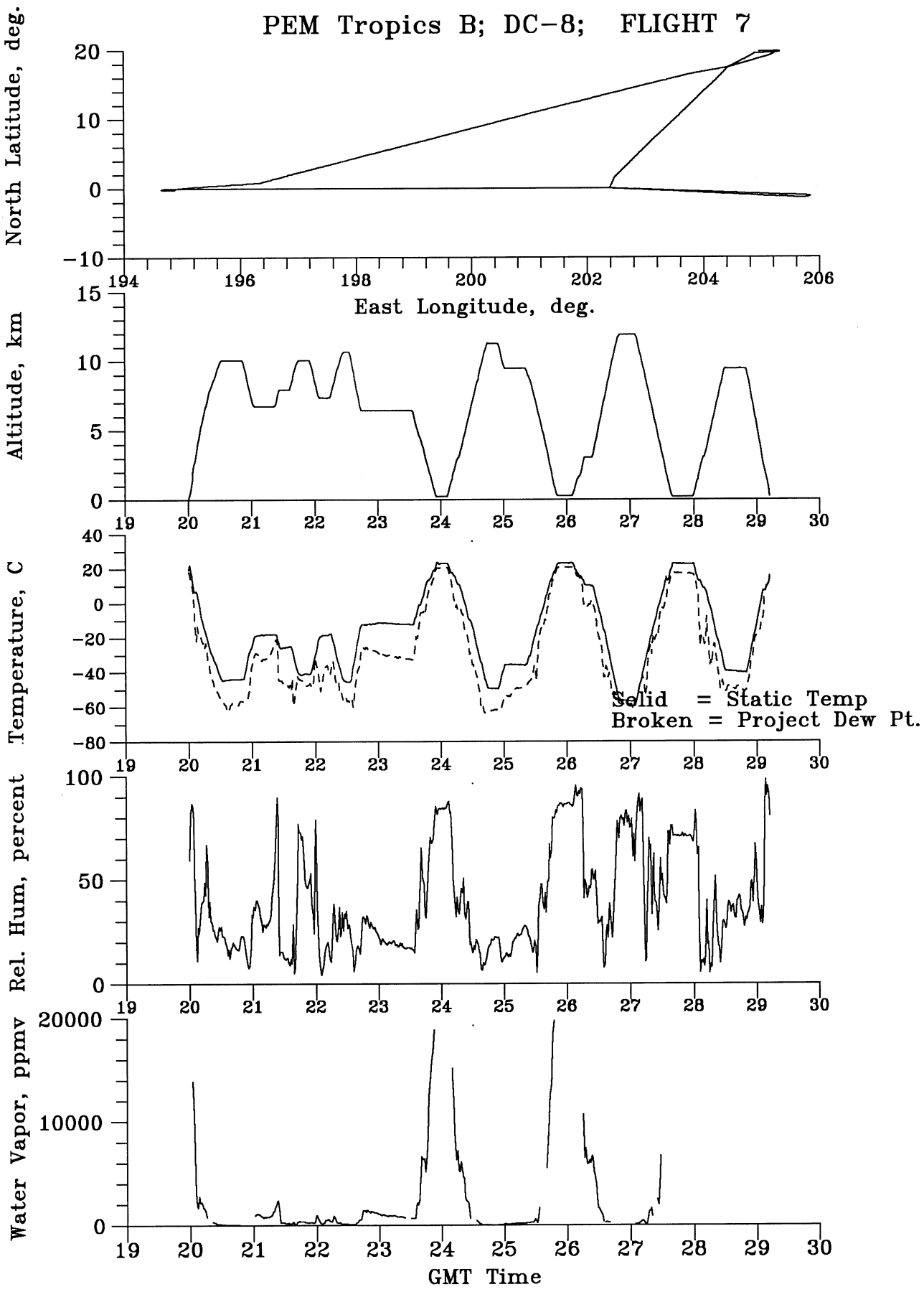
PEM-TROPICS B

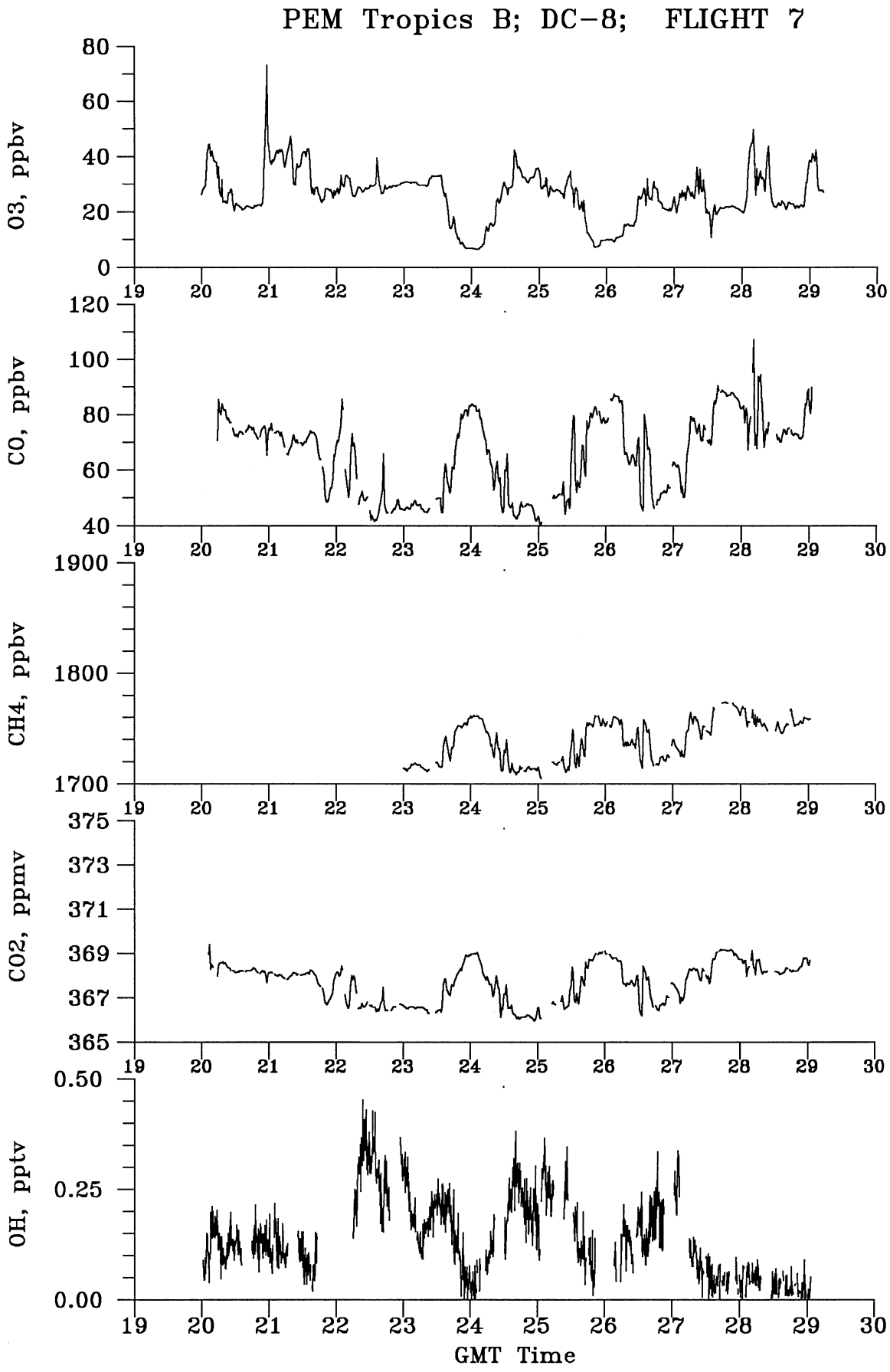
Flight 7D

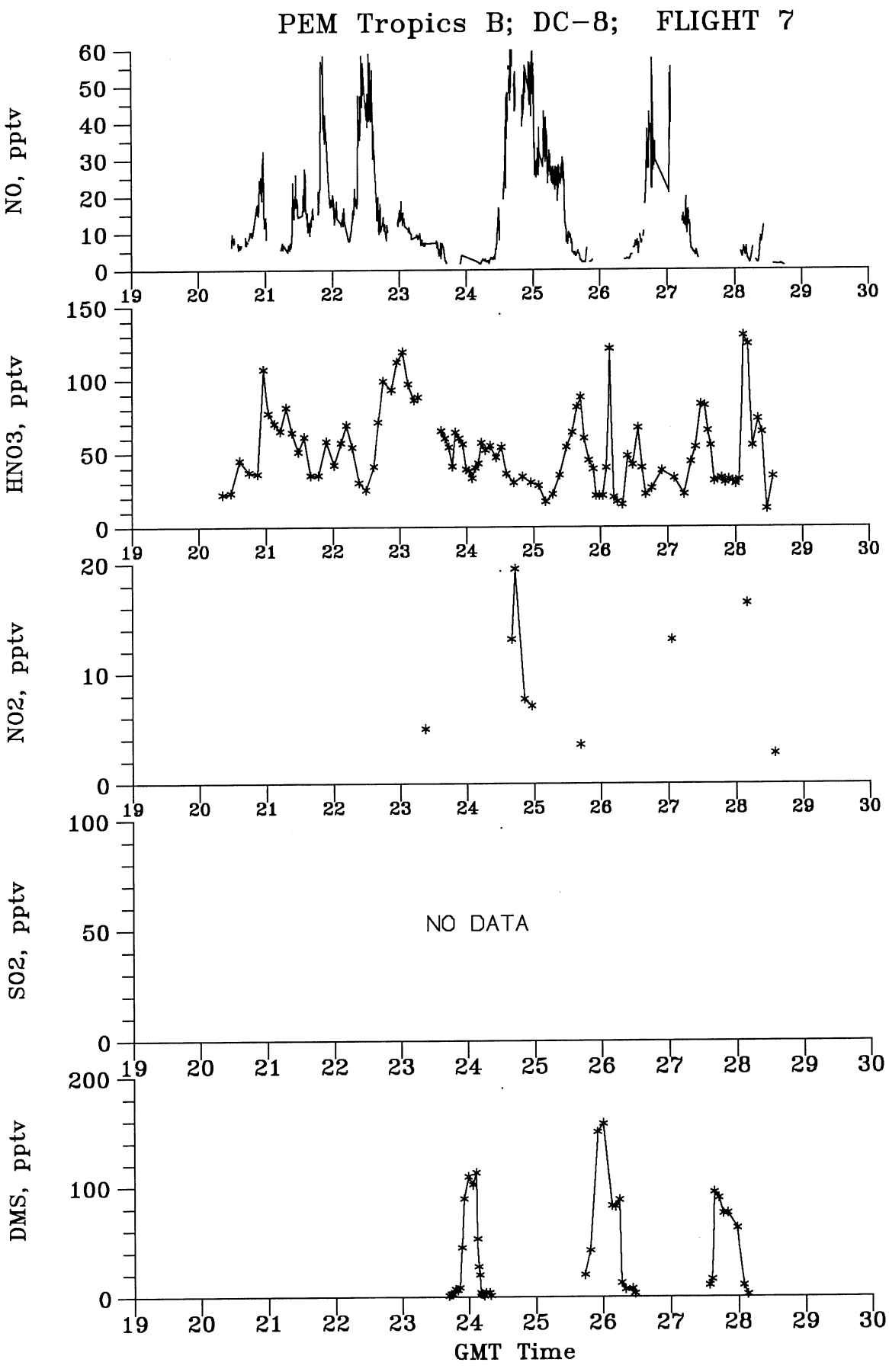
Local: Hilo No. 2

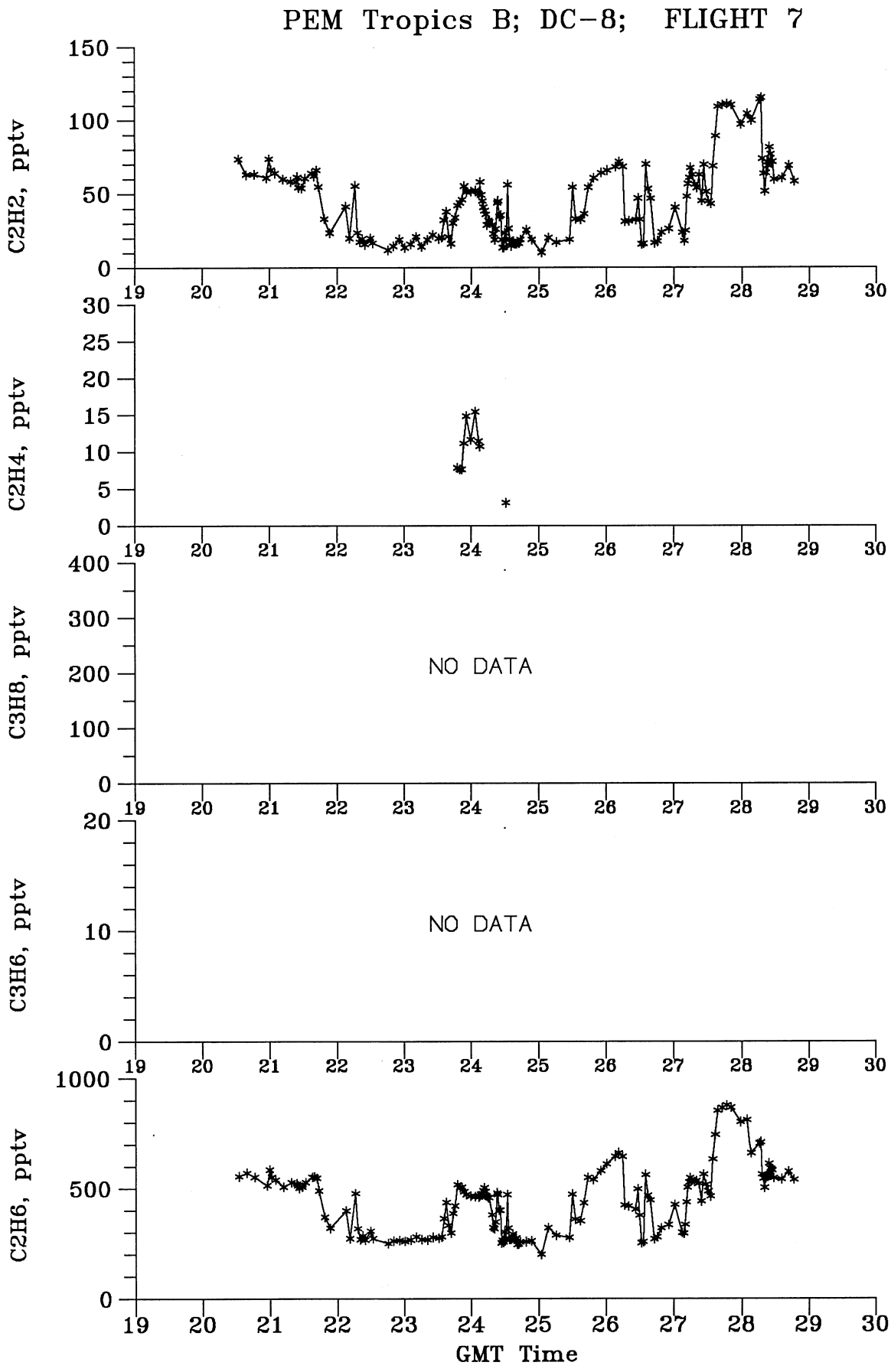
Equatorial Chemistry

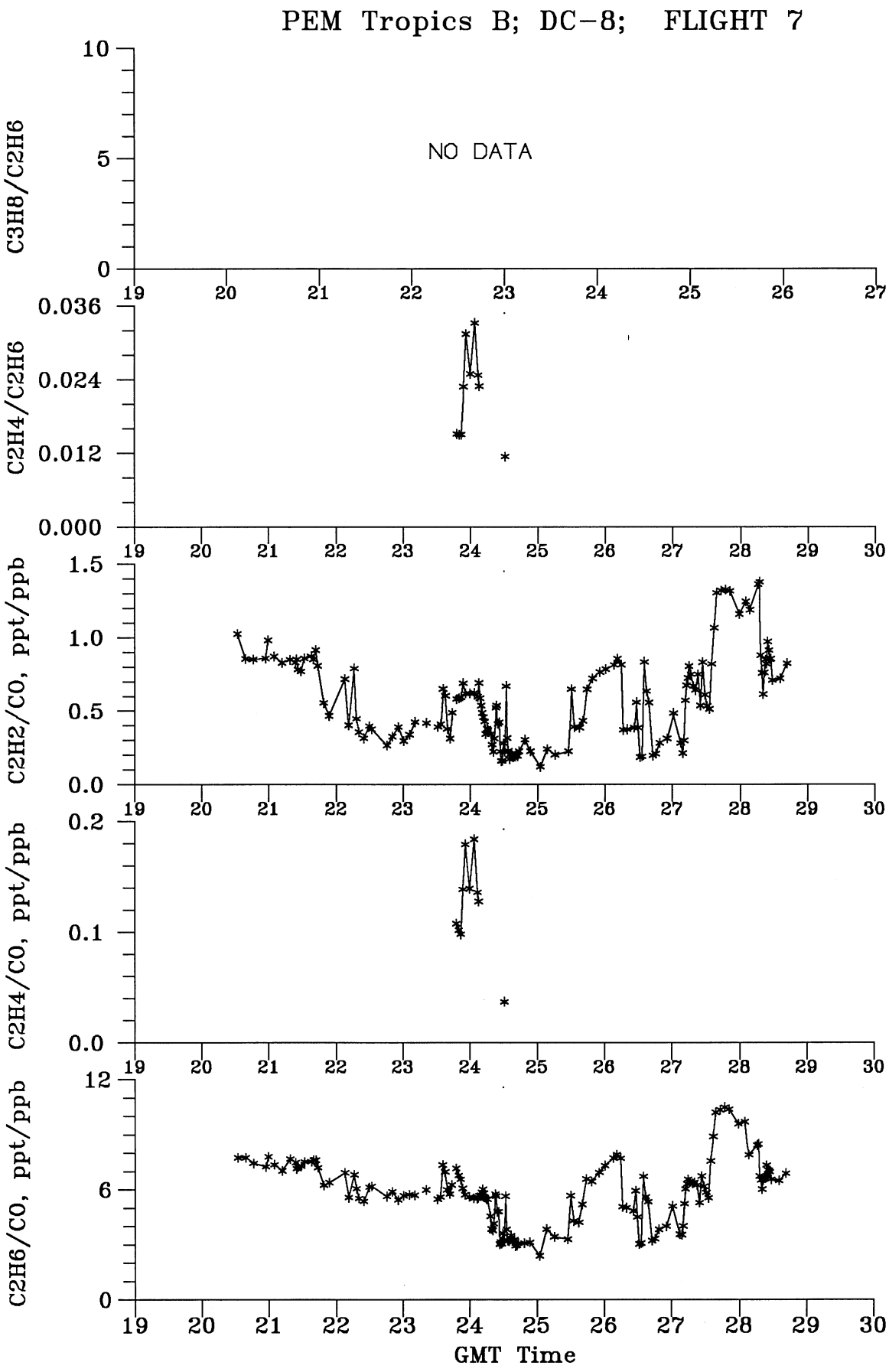
March 13, 1999

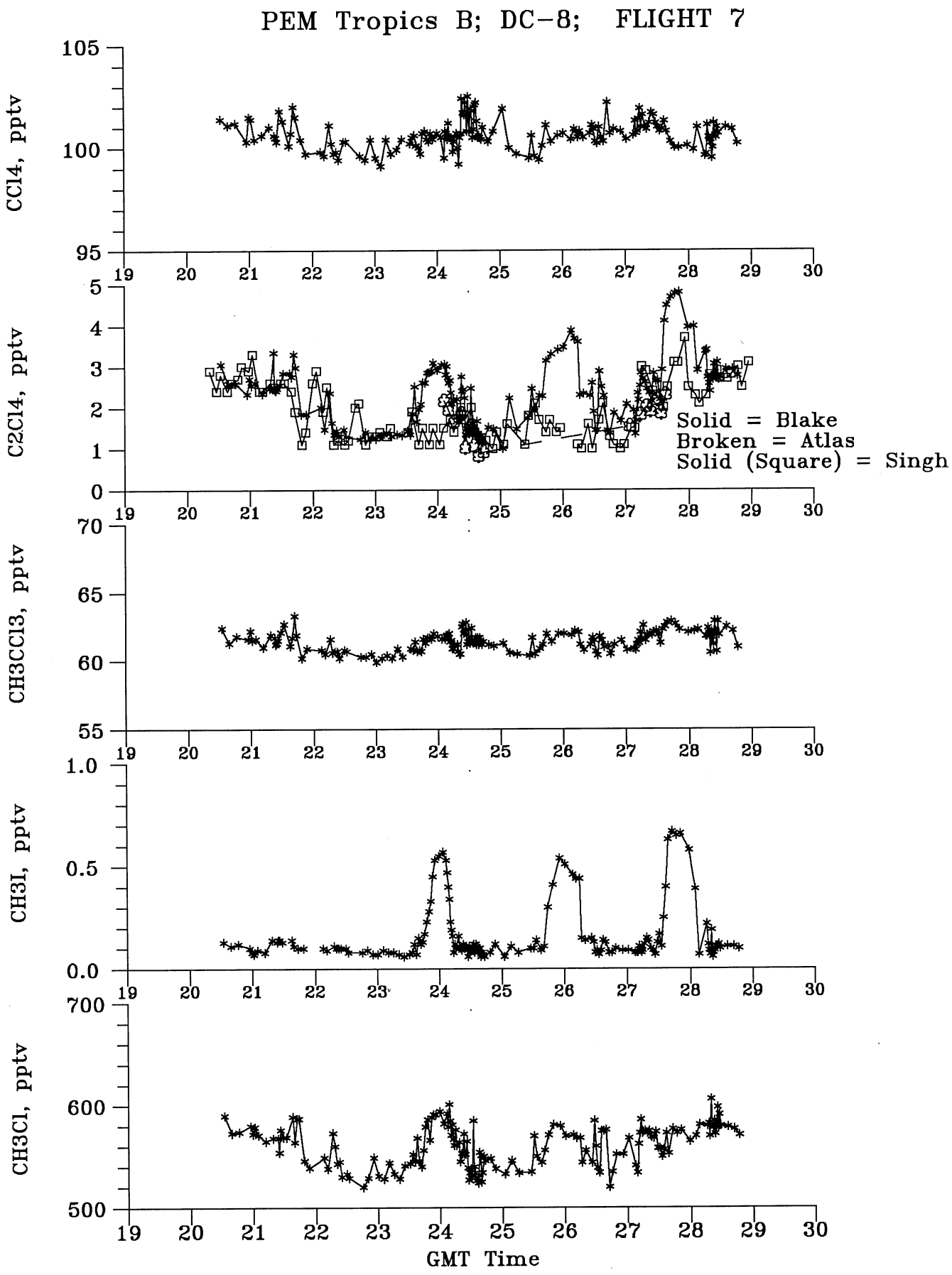

PEM Tropics B; DC-8; FLIGHT 7
North Latitude, deg.
20
10
0
-10
194
196
198
200
202
204
206
East Longitude, deg.
Altitude, km
15
10
5
0
19
20
21
22
23
24
25
26
27
28
29
30
Temperature, C
40
20
0
-20
-40
-60
-80
Solid = Static Temp
Broken = Project Dew Pt.
Rel. Hum, percent
100
50
0
Water Vapor, ppmv
20000
10000
0
GMT Time

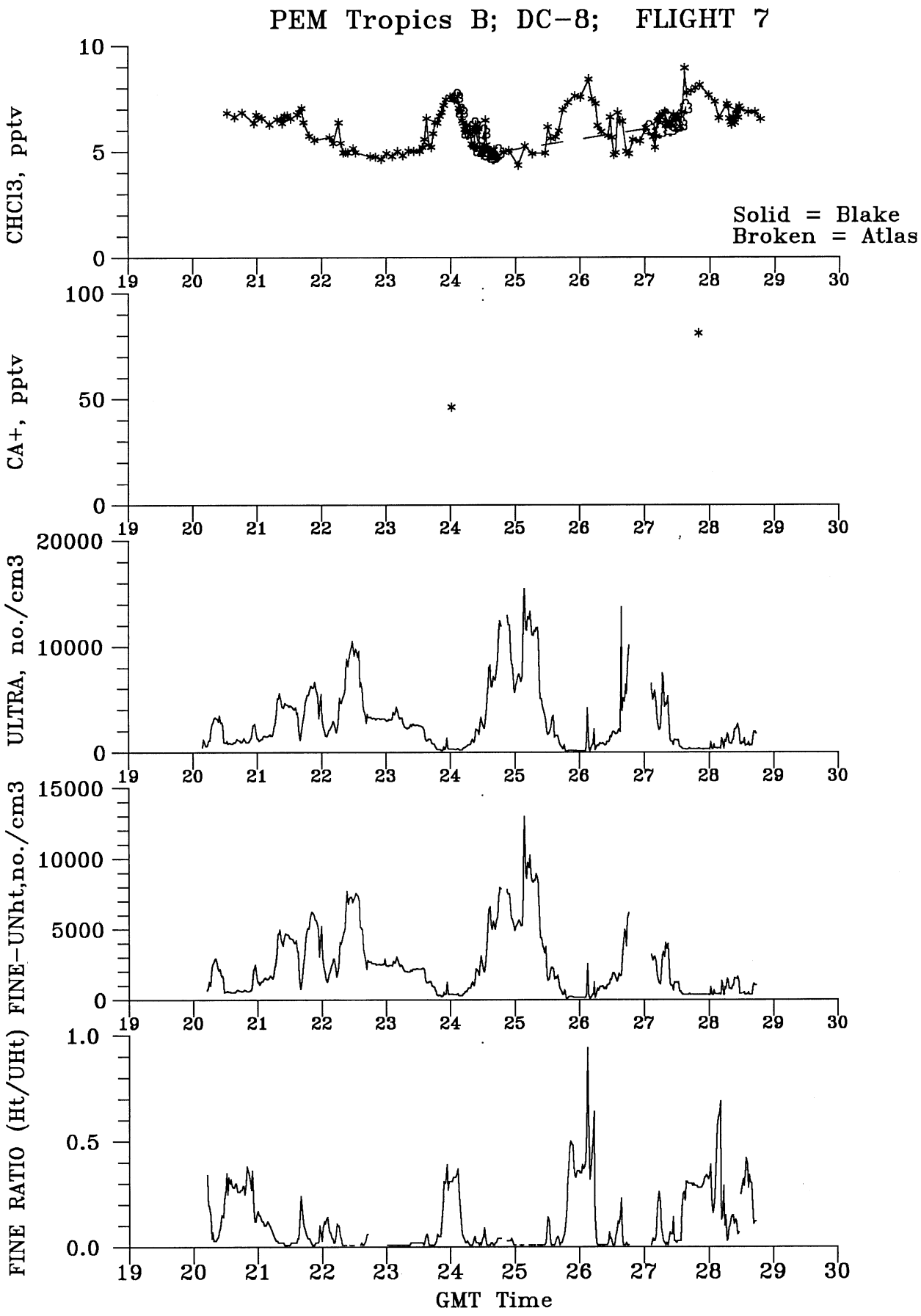

PEM Tropics B; DC-8; FLIGHT 7
O3, ppbv
80
60
40
20
0
CO, ppbv
120
100
80
60
40
CH4, ppbv
1900
1800
1700
CO2, ppmv
375
373
371
369
367
365
OH, pptv
0.50
0.25
0.00
19
20
21
22
23
24
25
26
27
28
29
30
GMT Time

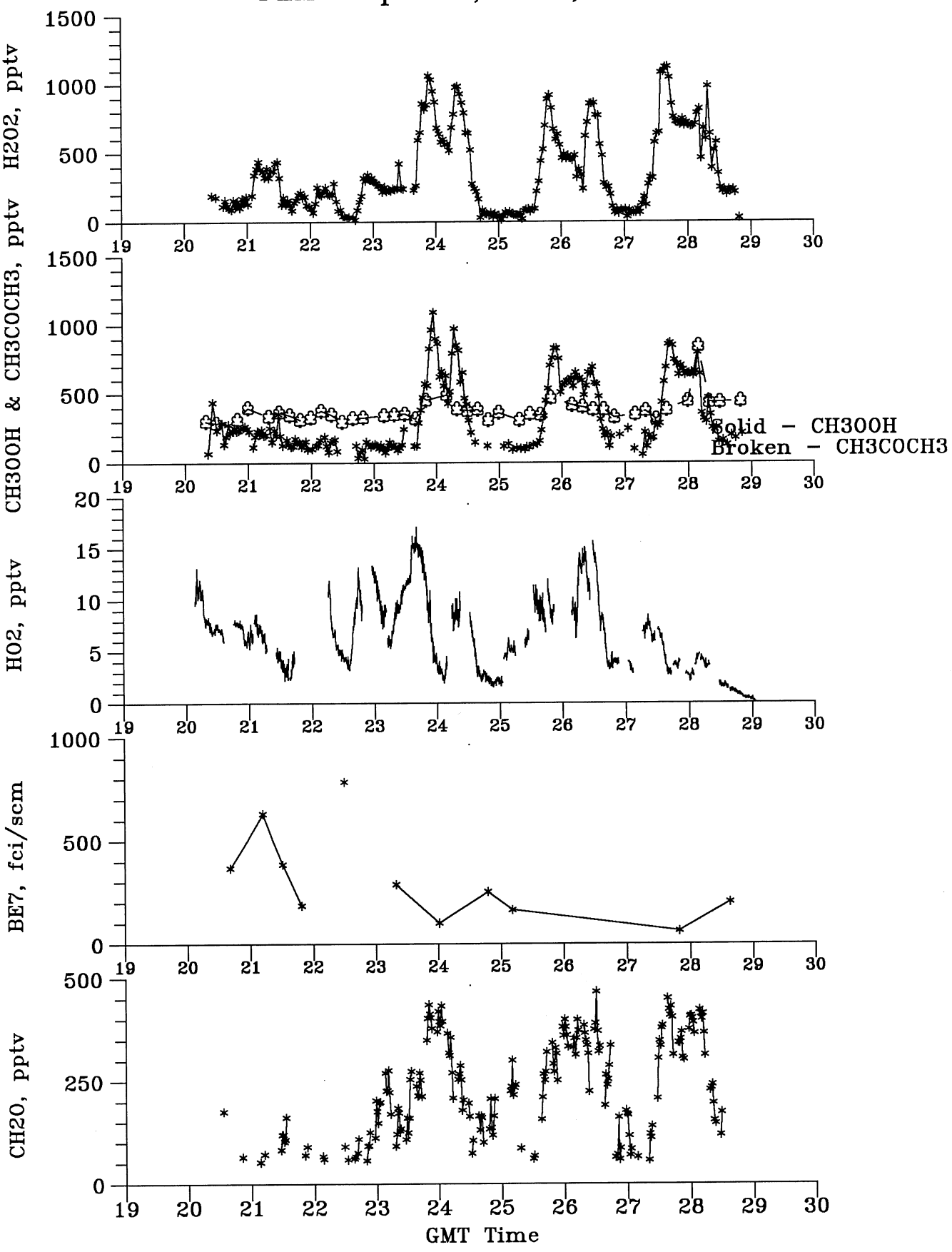

PEM Tropics B; DC-8; FLIGHT 7
NO, pptv
HNO3, pptv
NO2, pptv
SO2, pptv
NO DATA
DMS, pptv
GMT Time

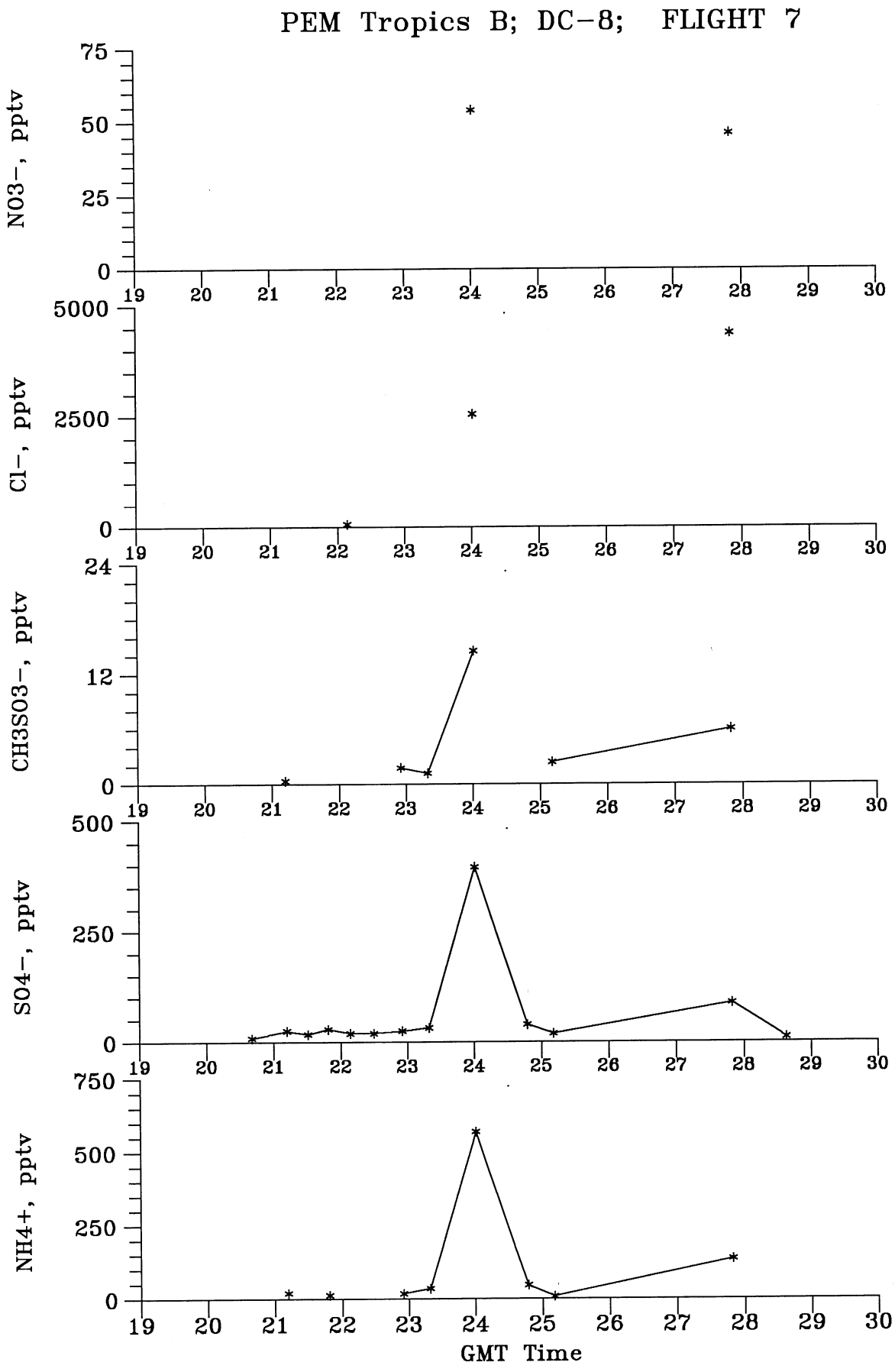

PEM Tropics B; DC-8; FLIGHT 7
C2H2, pptv
150
100
50
0
C2H4, pptv
30
25
20
15
10
5
0
C3H8, pptv
400
300
200
100
0
NO DATA
C3H6, pptv
20
10
0
NO DATA
C2H6, pptv
1000
500
0
19
20
21
22
23
24
25
26
27
28
29
30
GMT Time

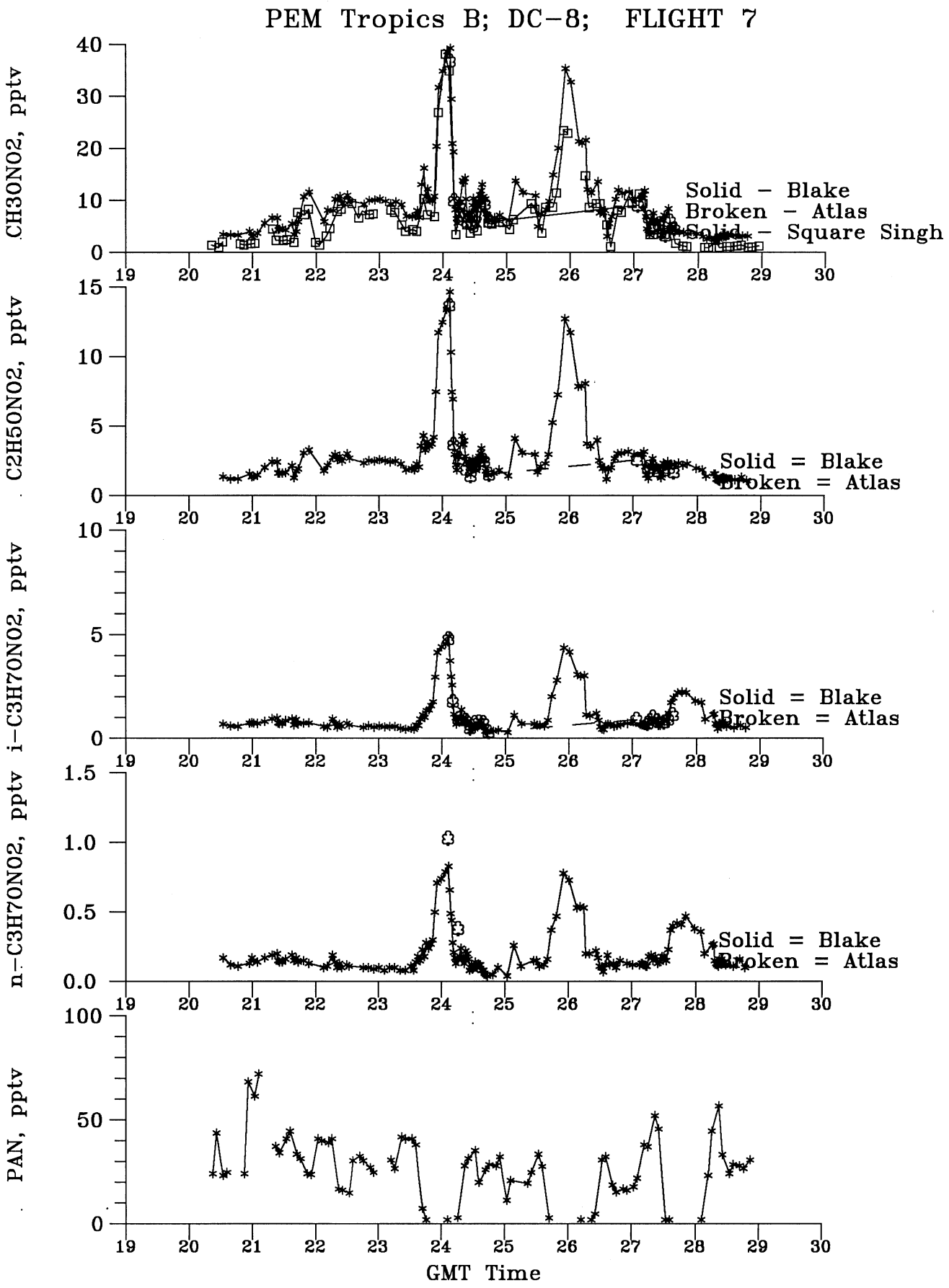

PEM Tropics B; DC-8; FLIGHT 7
C3H8/C2H6
NO DATA
C2H4/C2H6
C2H2/CO, ppt/ppb
C2H4/CO, ppt/ppb
C2H6/CO, ppt/ppb
GMT Time

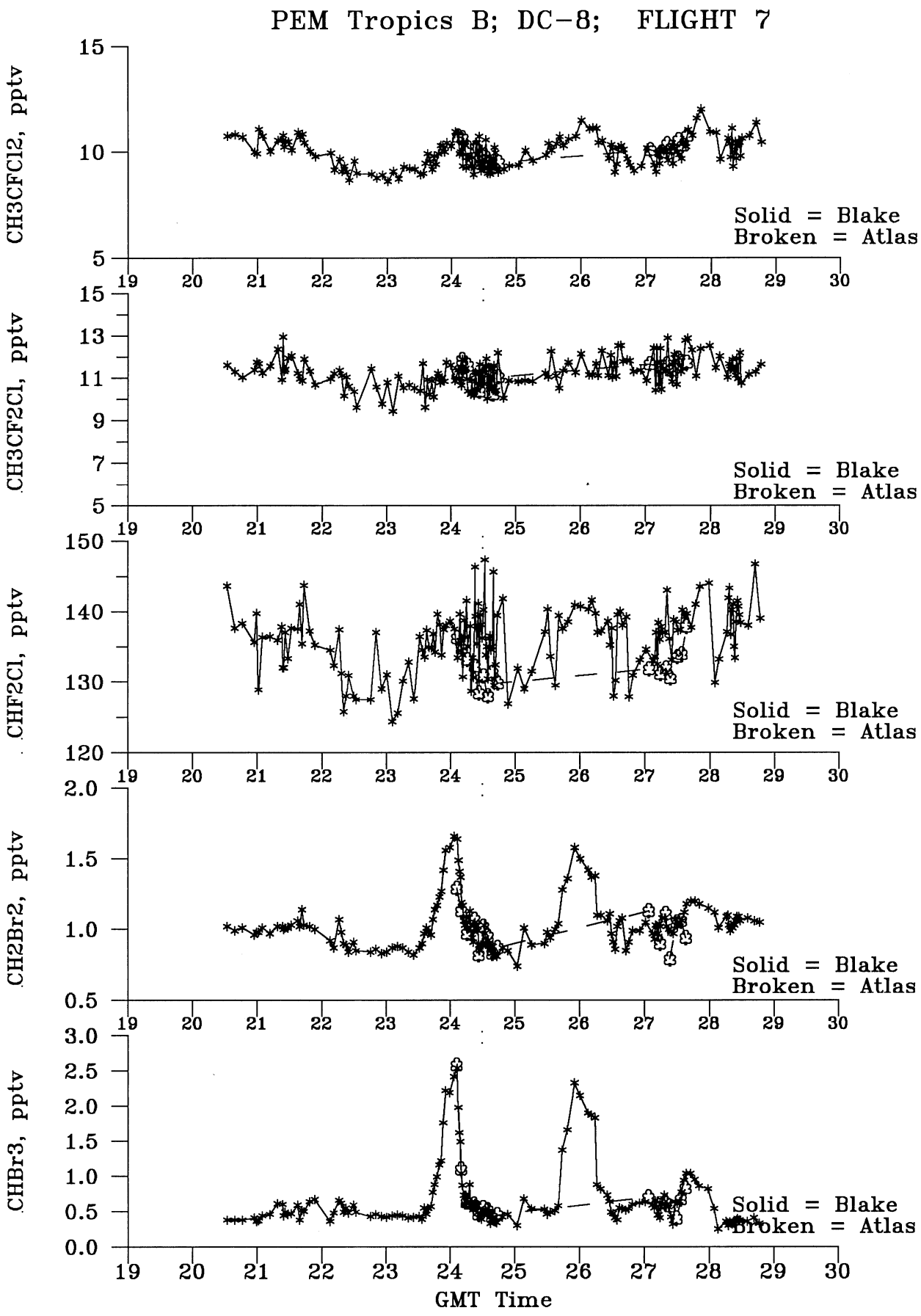

PEM Tropics B; DC-8; FLIGHT 7
CCl4, pptv
105
100
95
C2Cl4, pptv
5
4
3
2
1
0
Solid = Blake
Broken = Atlas
Solid (Square) = Singh
CH3CCl3, pptv
70
65
60
55
CH3I, pptv
1.0
0.5
0.0
CH3Cl, pptv
700
600
500
19
20
21
22
23
24
25
26
27
28
29
30
GMT Time

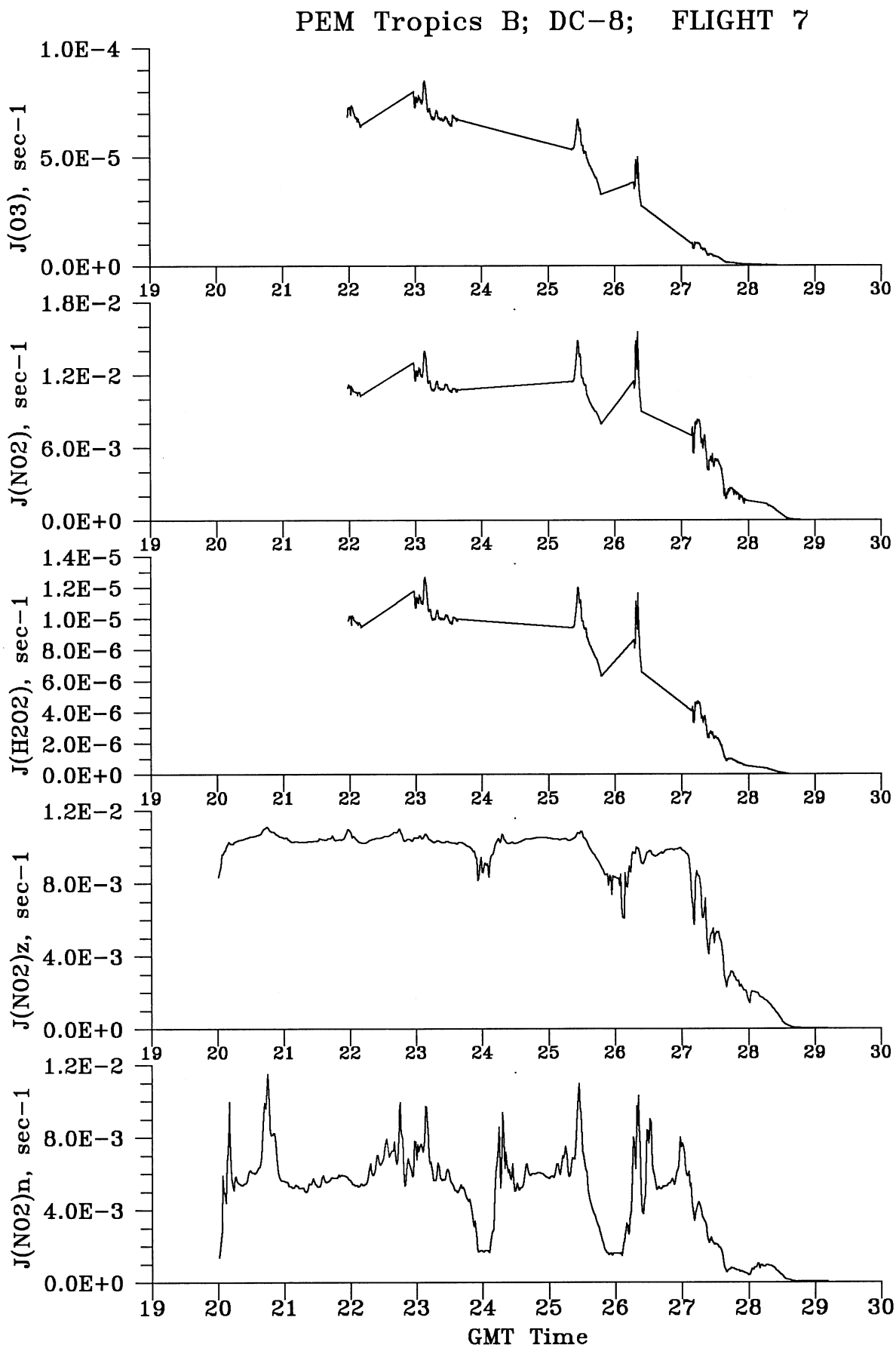

PEM Tropics B; DC-8; FLIGHT 7
CHCl3, pptv
Solid = Blake
Broken = Atlas
CA+, pptv
ULTRA, no./cm3
FINE-UNht,no./cm3
FINE RATIO (Ht/UHt)
GMT Time

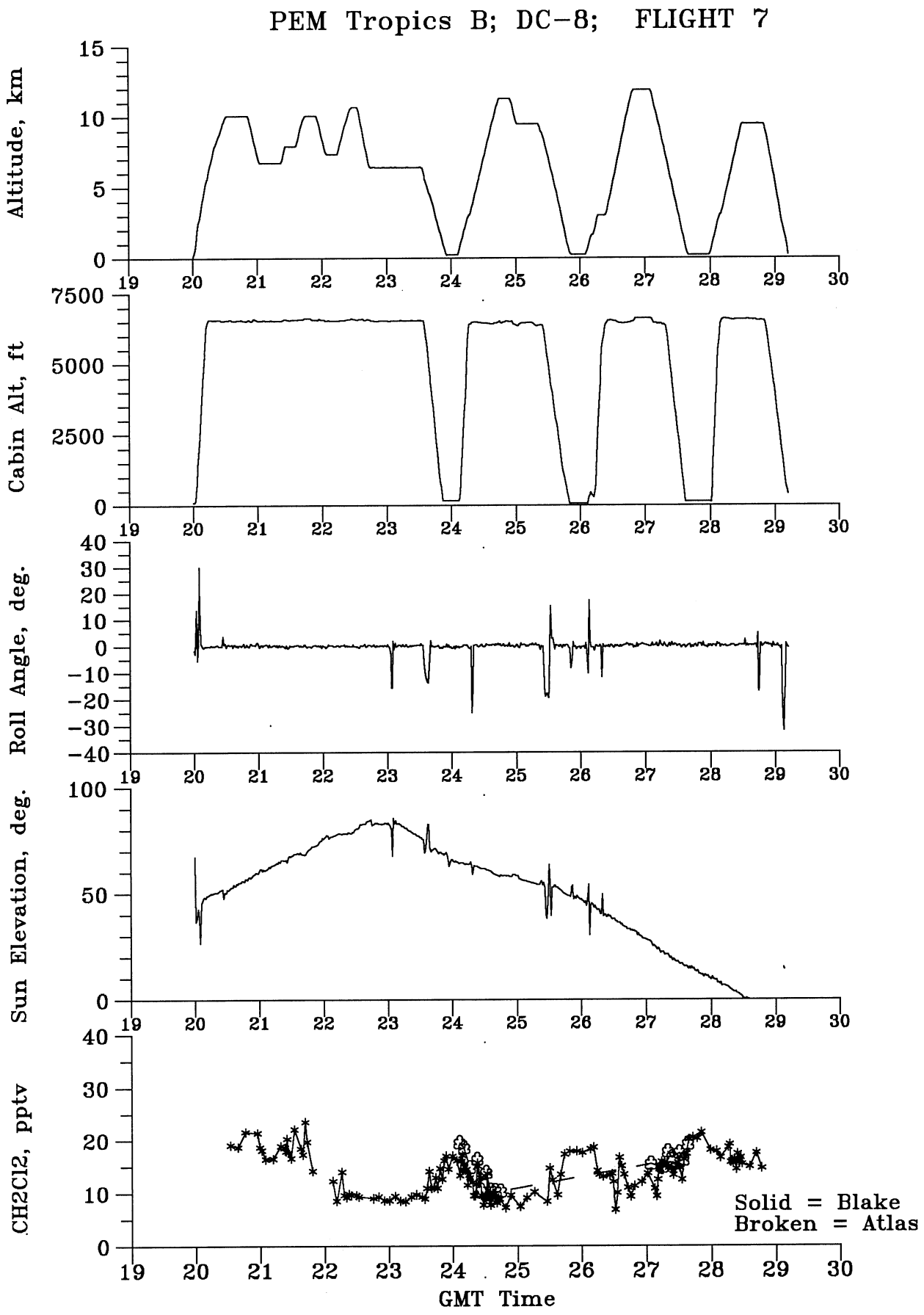

PEM Tropics B; DC-8; FLIGHT 7
H2O2, pptv
CH3OOH & CH3COCH3, pptv
Solid - CH3OOH
Broken - CH3COCH3
HO2, pptv
BE7, fci/scm
CH2O, pptv
GMT Time


PEM Tropics B; DC-8; FLIGHT 7
NO3-, pptv
75
50
25
0
Cl-, pptv
5000
2500
0
CH3SO3-, pptv
24
12
0
SO4-, pptv
500
250
0
NH4+, pptv
750
500
250
0
19 20 21 22 23 24 25 26 27 28 29 30
GMT Time

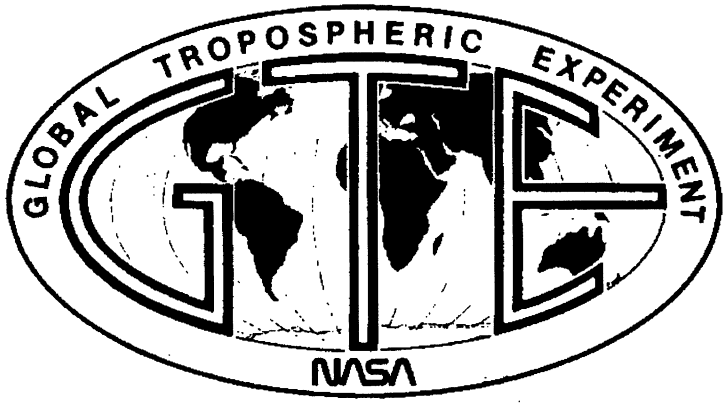

PEM Tropics B; DC-8; FLIGHT 7
CH3ONO2, pptv
Solid - Blake
Broken - Atlas
Solid - Square Singh
C2H5ONO2, pptv
Solid = Blake
Broken = Atlas
n-C3H7ONO2, pptv i-C3H7ONO2, pptv
Solid = Blake
Broken = Atlas
Solid = Blake
Broken = Atlas
PAN, pptv
GMT Time


PEM Tropics B; DC-8; FLIGHT 7
CH3CFCl2, pptv
15
10
5
Solid = Blake
Broken = Atlas
CH3CF2Cl, pptv
15
13
11
9
7
5
Solid = Blake
Broken = Atlas
CHF2Cl, pptv
150
140
130
120
Solid = Blake
Broken = Atlas
CH2Br2, pptv
2.0
1.5
1.0
0.5
Solid = Blake
Broken = Atlas
CHBr3, pptv
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Solid = Blake
Broken = Atlas
19 20 21 22 23 24 25 26 27 28 29 30
GMT Time


PEM Tropics B; DC-8; FLIGHT 7
J(O3), sec-1
1.0E-4
5.0E-5
0.0E+0
J(NO2), sec-1
1.8E-2
1.2E-2
6.0E-3
0.0E+0
J(H2O2), sec-1
1.4E-5
1.2E-5
1.0E-5
8.0E-6
6.0E-6
4.0E-6
2.0E-6
0.0E+0
J(NO2)z, sec-1
1.2E-2
8.0E-3
4.0E-3
0.0E+0
J(NO2)n, sec-1
1.2E-2
8.0E-3
4.0E-3
0.0E+0
19 20 21 22 23 24 25 26 27 28 29 30
GMT Time


PEM Tropics B; DC-8; FLIGHT 7
Altitude, km
15
10
5
0
Cabin Alt, ft
7500
5000
2500
0
Roll Angle, deg.
40
30
20
10
0
-10
-20
-30
-40
Sun Elevation, deg.
100
50
0
CH2Cl2, pptv
40
30
20
10
0
19
20
21
22
23
24
25
26
27
28
29
30
GMT Time
Solid = Blake
Broken = Atlas

PLOTS OF FINAL CHEMICAL DATA



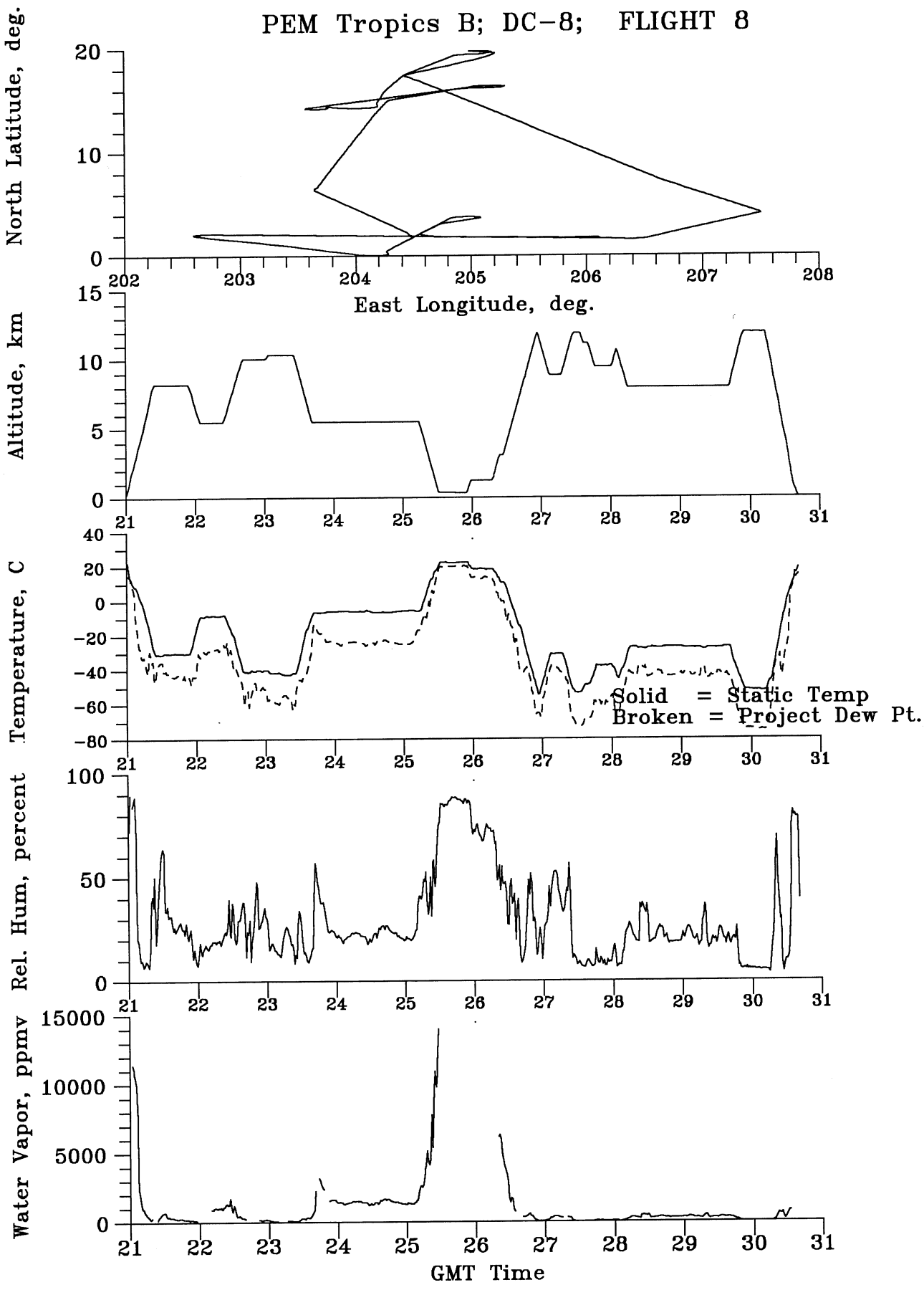
PEM-TROPICS B

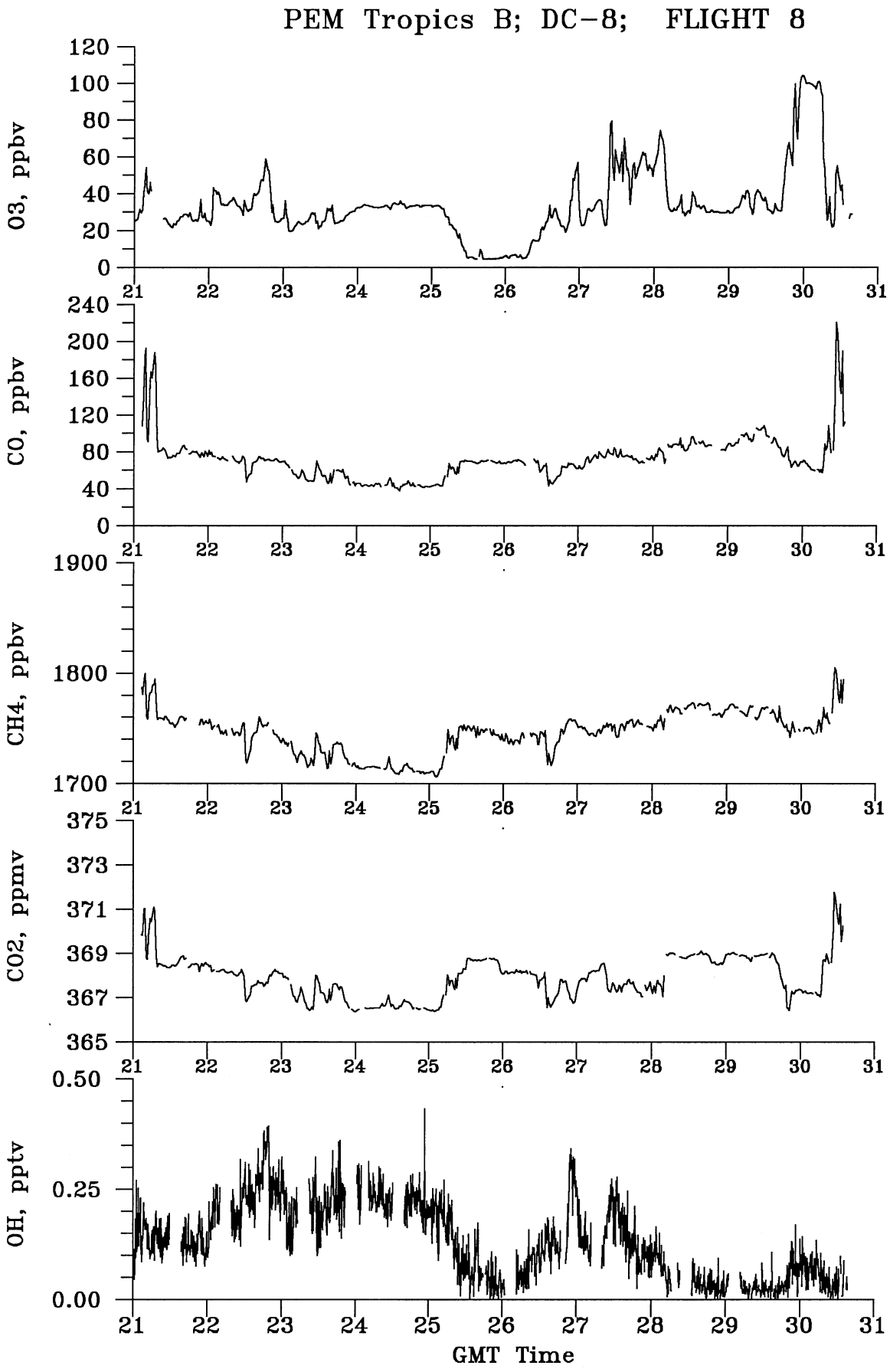
Flight 8D

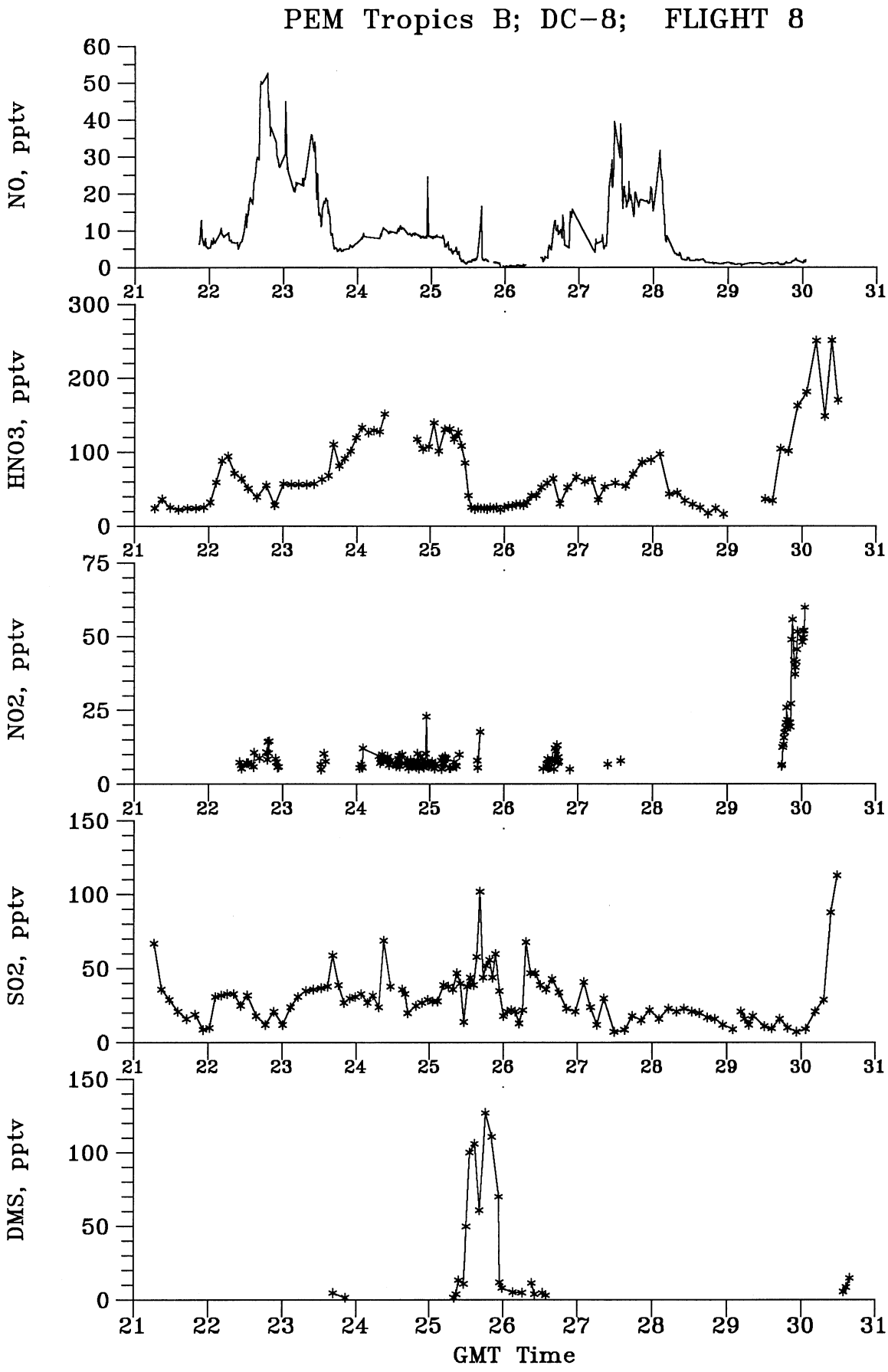
Local: Hilo No. 3

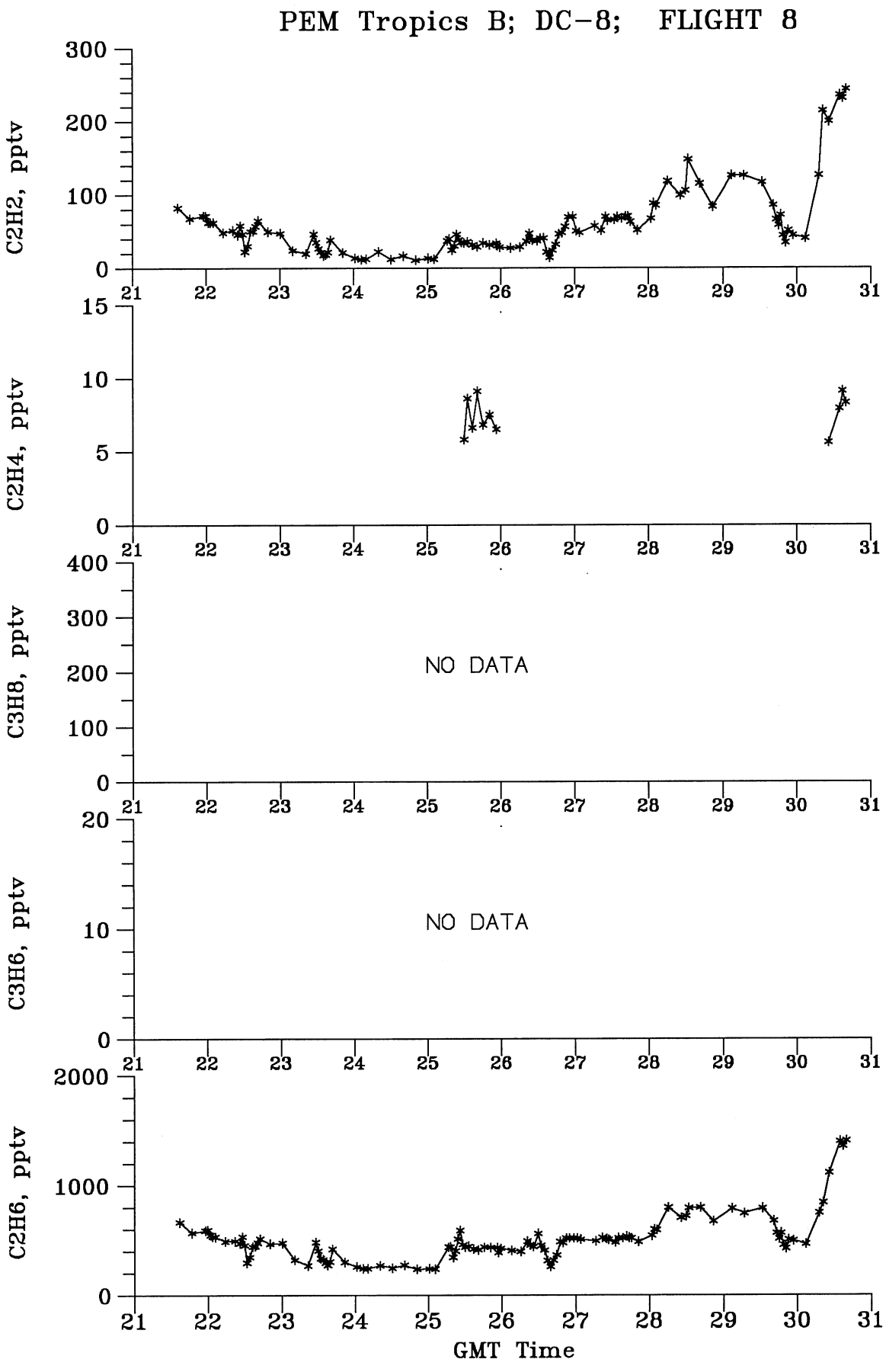
Sunset Photochemistry

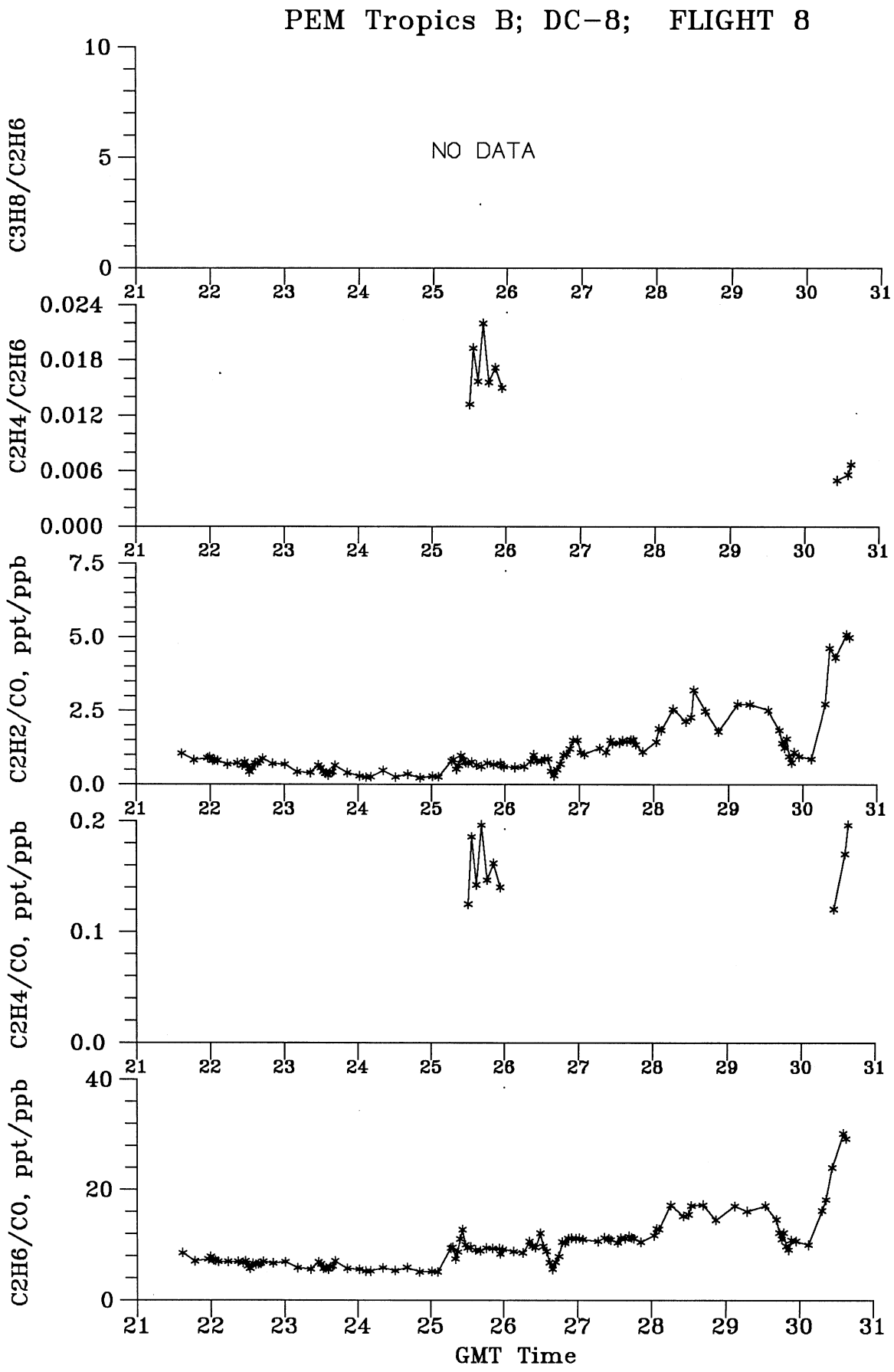
March 15, 1999

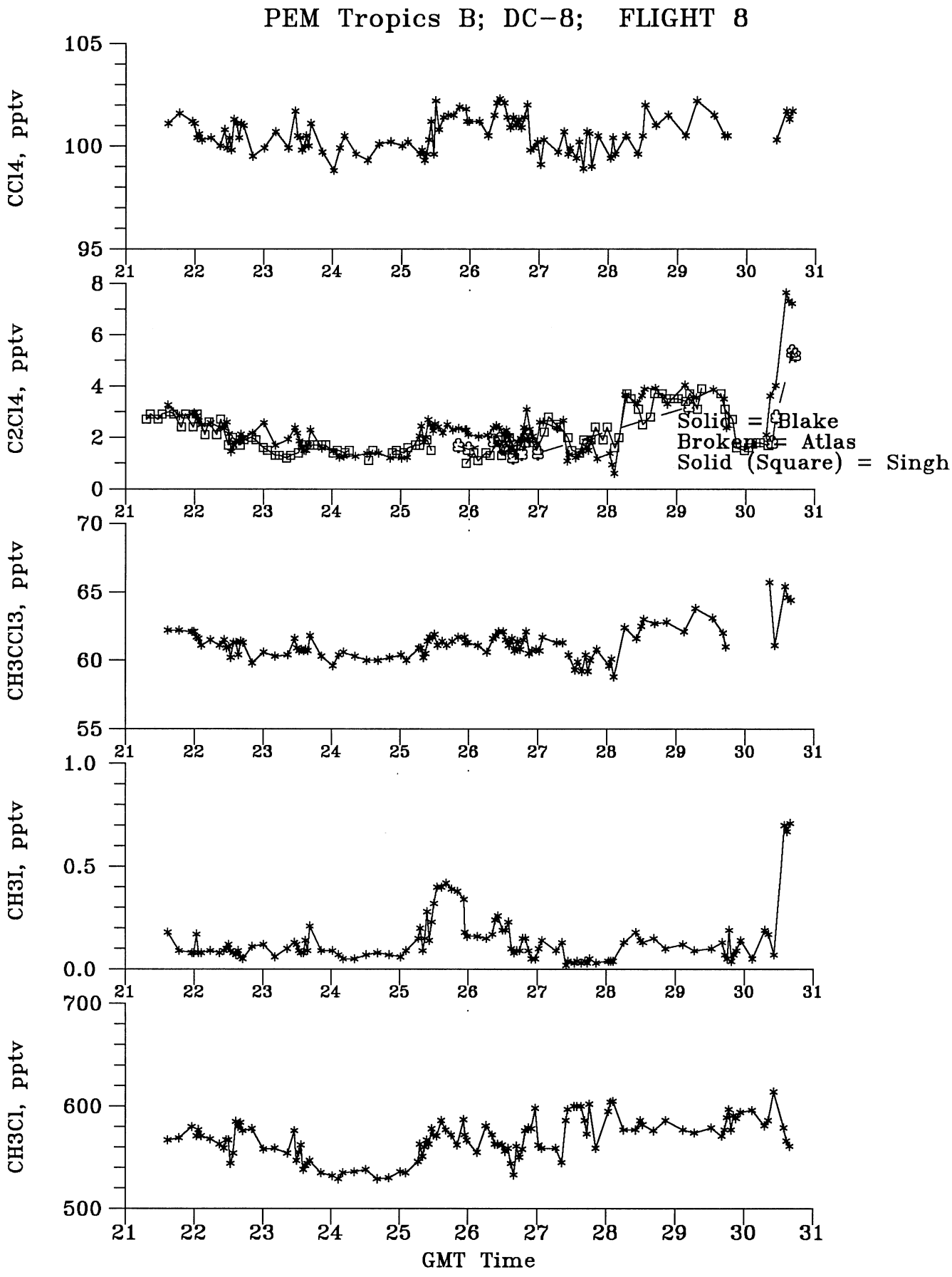

PEM Tropics B; DC-8; FLIGHT 8
North Latitude, deg.
East Longitude, deg.
Altitude, km
Temperature, C
Solid = Static Temp
Broken = Project Dew Pt.
Rel. Hum, percent
Water Vapor, ppmv
GMT Time

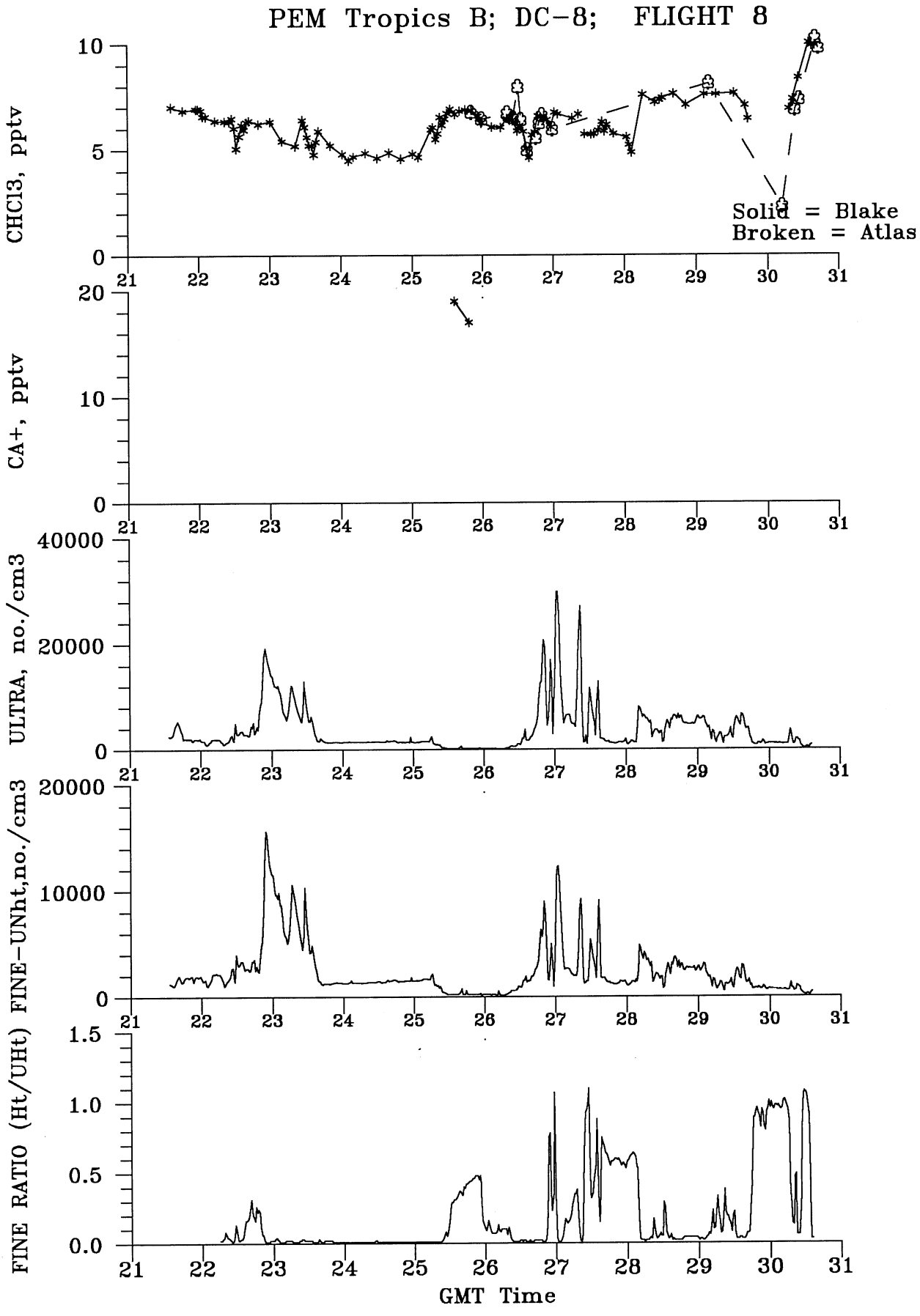

PEM Tropics B; DC-8; FLIGHT 8
O3, ppbv
120
100
80
60
40
20
0
CO, ppbv
240
200
160
120
80
40
0
CH4, ppbv
1900
1800
1700
CO2, ppmv
375
373
371
369
367
365
OH, pptv
0.50
0.25
0.00
21
22
23
24
25
26
27
28
29
30
31
GMT Time

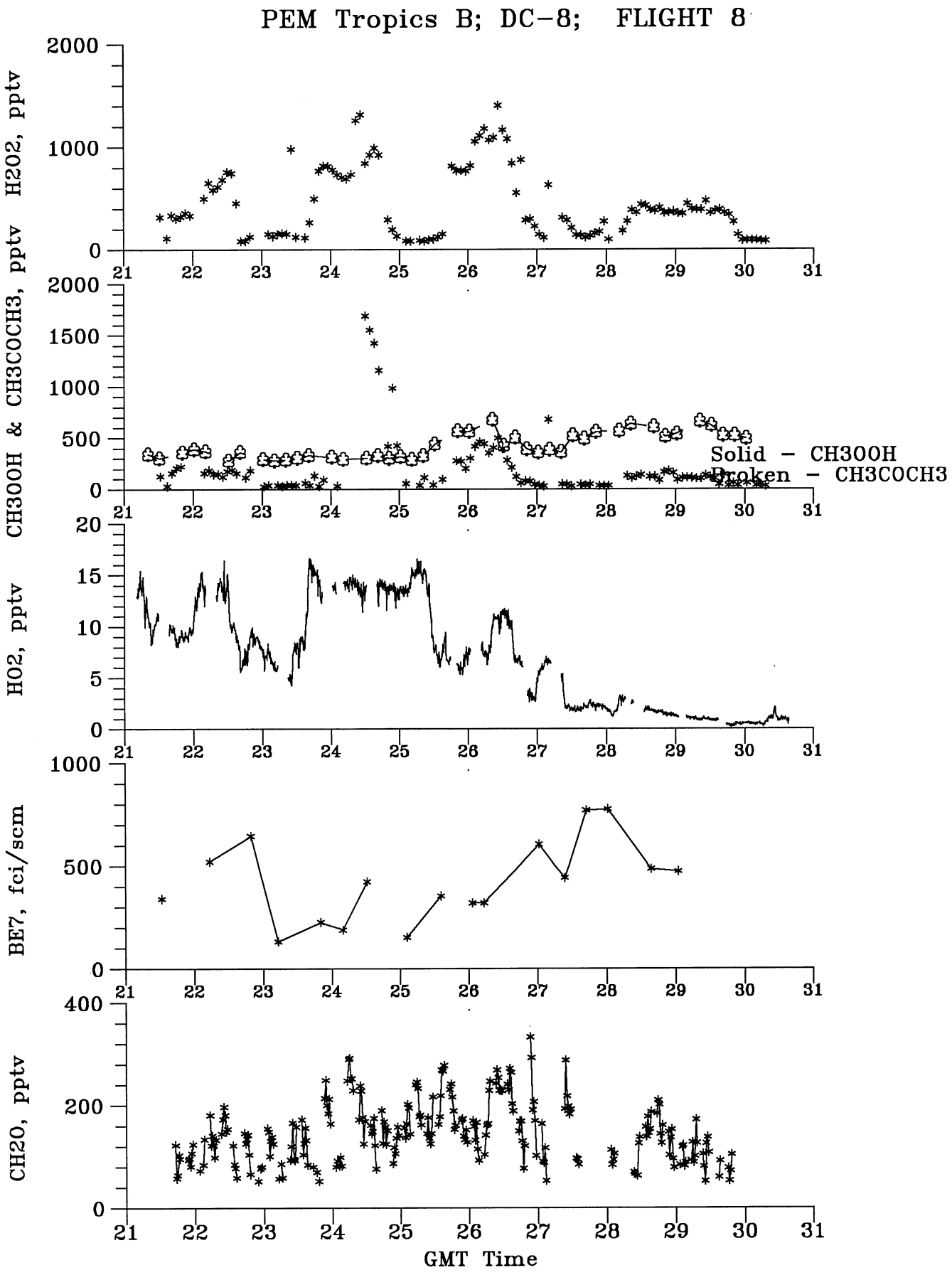

PEM Tropics B; DC-8; FLIGHT 8
NO, pptv
HNO3, pptv
NO2, pptv
SO2, pptv
DMS, pptv
GMT Time
21
22
23
24
25
26
27
28
29
30
31

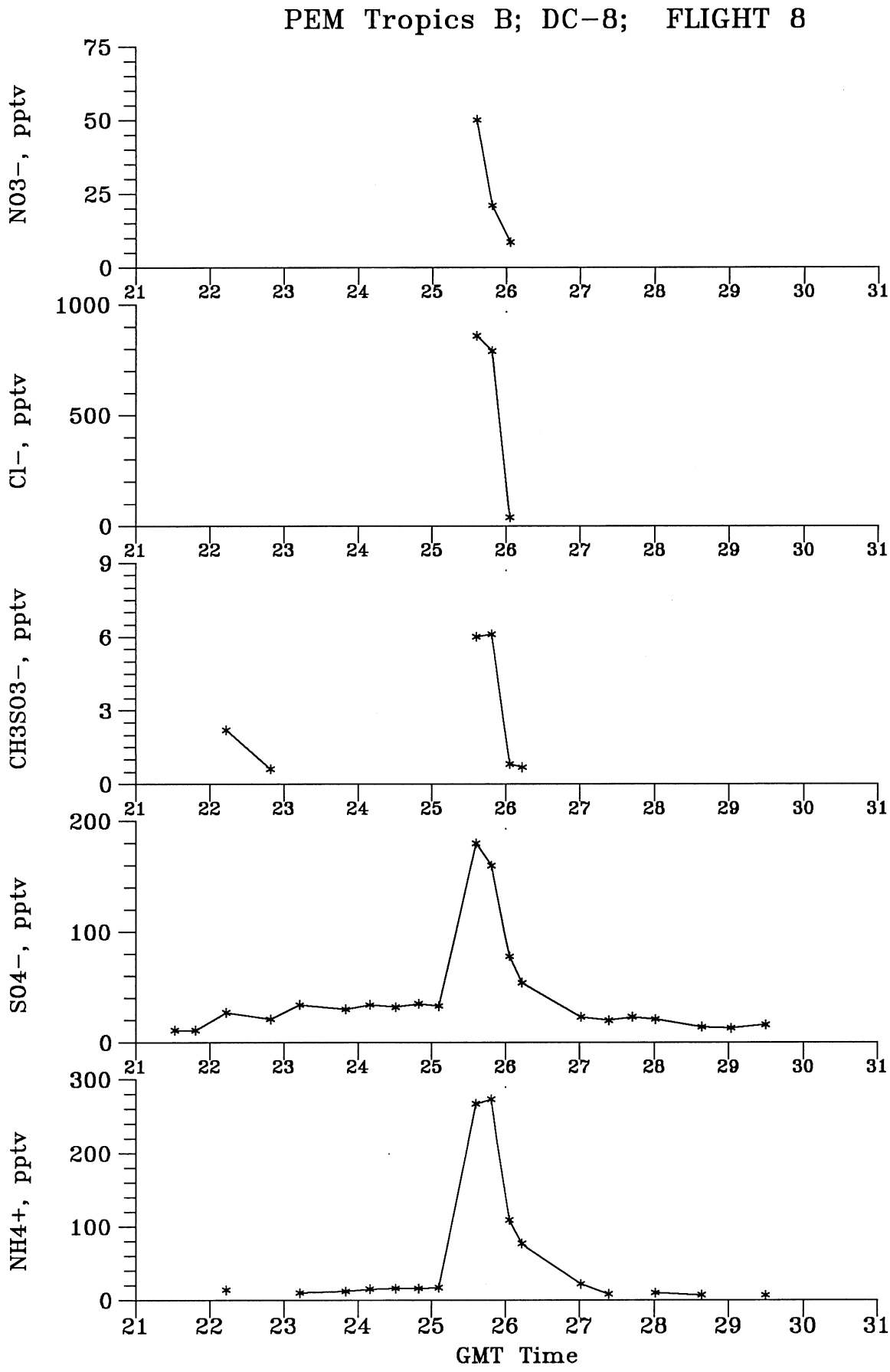

PEM Tropics B; DC-8; FLIGHT 8
C2H2, pptv
300
200
100
0
C2H4, pptv
15
10
5
0
C3H8, pptv
400
300
200
100
0
NO DATA
C3H6, pptv
20
10
0
NO DATA
C2H6, pptv
2000
1000
0
21
22
23
24
25
26
27
28
29
30
31
GMT Time

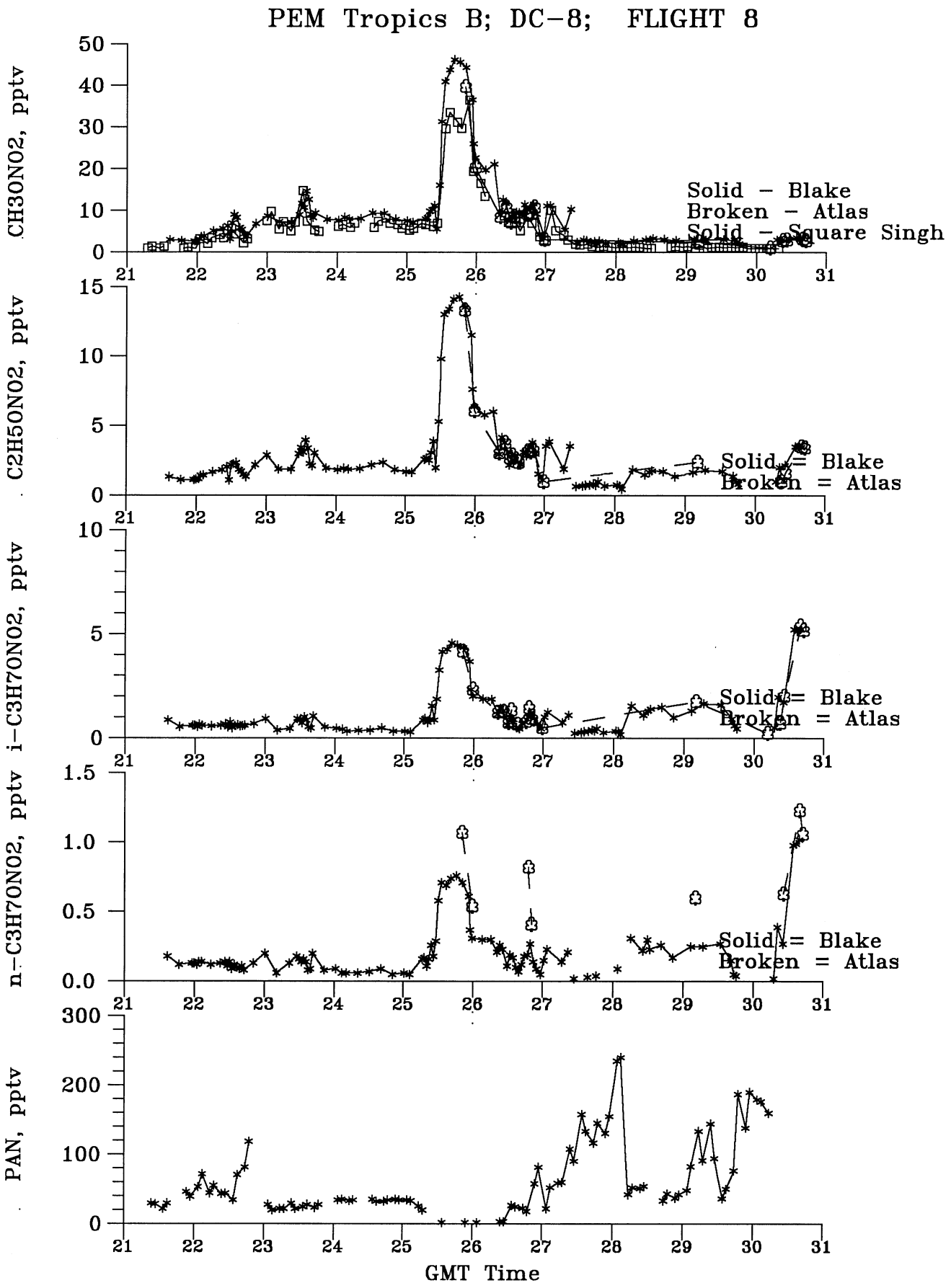

PEM Tropics B; DC-8; FLIGHT 8
NO DATA
C3H8/C2H6
C2H4/C2H6
C2H2/CO, ppt/ppb
C2H4/CO, ppt/ppb
C2H6/CO, ppt/ppb
GMT Time

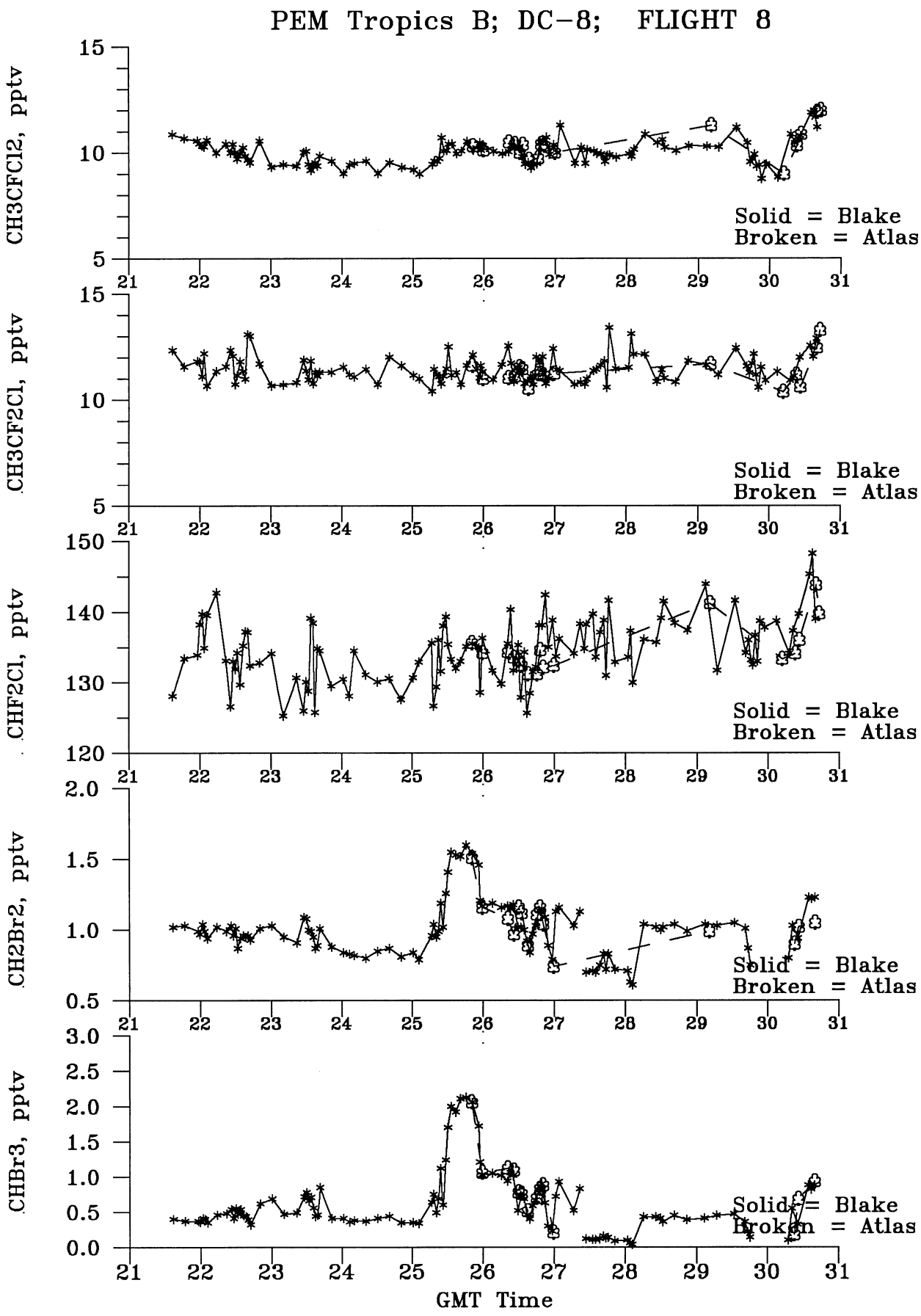

PEM Tropics B; DC-8; FLIGHT 8
CCl4, pptv
105
100
95
C2Cl4, pptv
8
6
4
2
0
Solid = Blake
Broken = Atlas
Solid (Square) = Singh
CH3CCl3, pptv
70
65
60
55
CH3I, pptv
1.0
0.5
0.0
CH3Cl, pptv
700
600
500
21
22
23
24
25
26
27
28
29
30
31
GMT Time

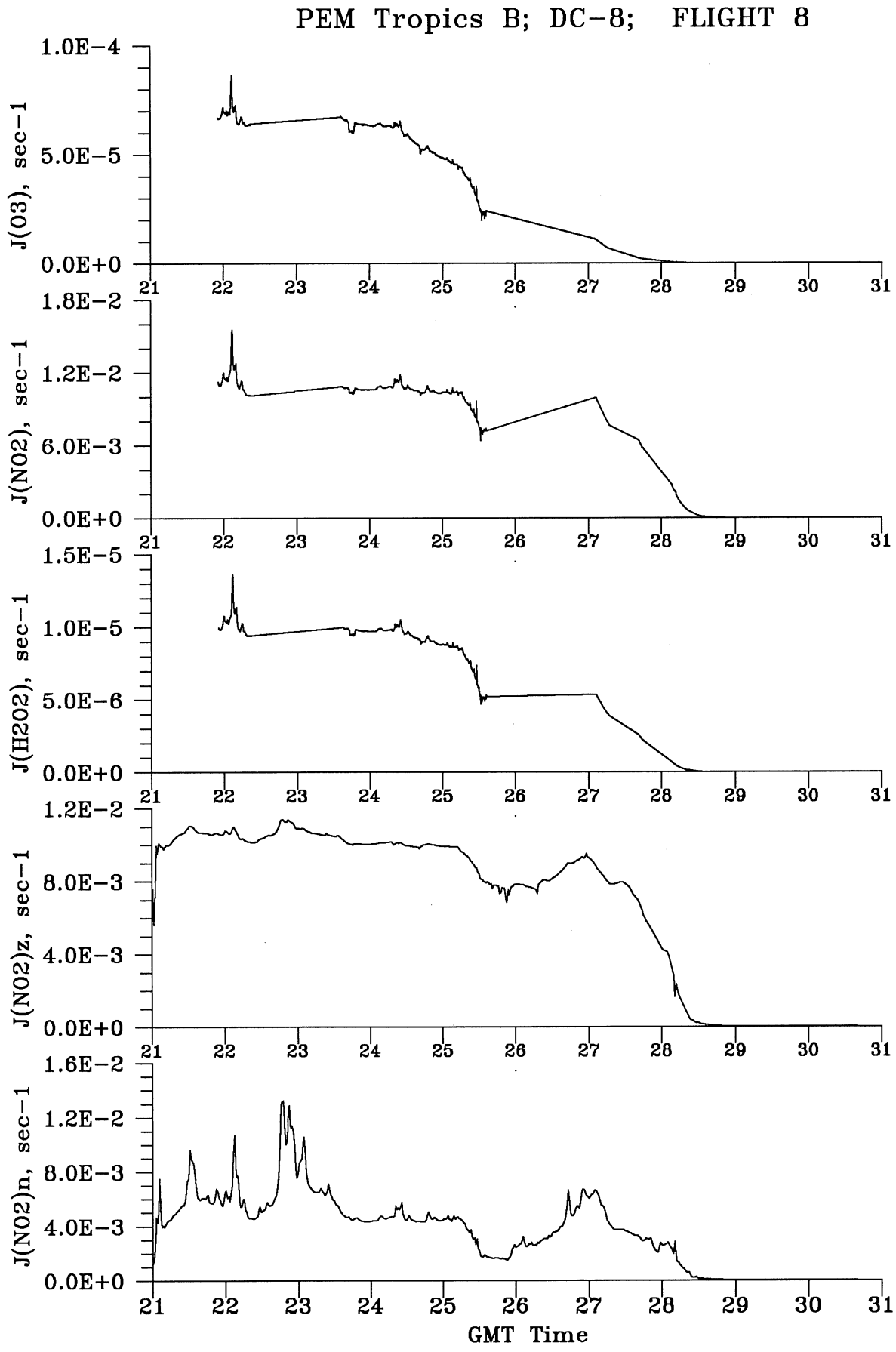

PEM Tropics B; DC-8; FLIGHT 8
CHCl3, pptv
Solid = Blake
Broken = Atlas
CA+, pptv
ULTRA, no./cm3
FINE-UNht,no./cm3
FINE RATIO (Ht/UHt)
GMT Time

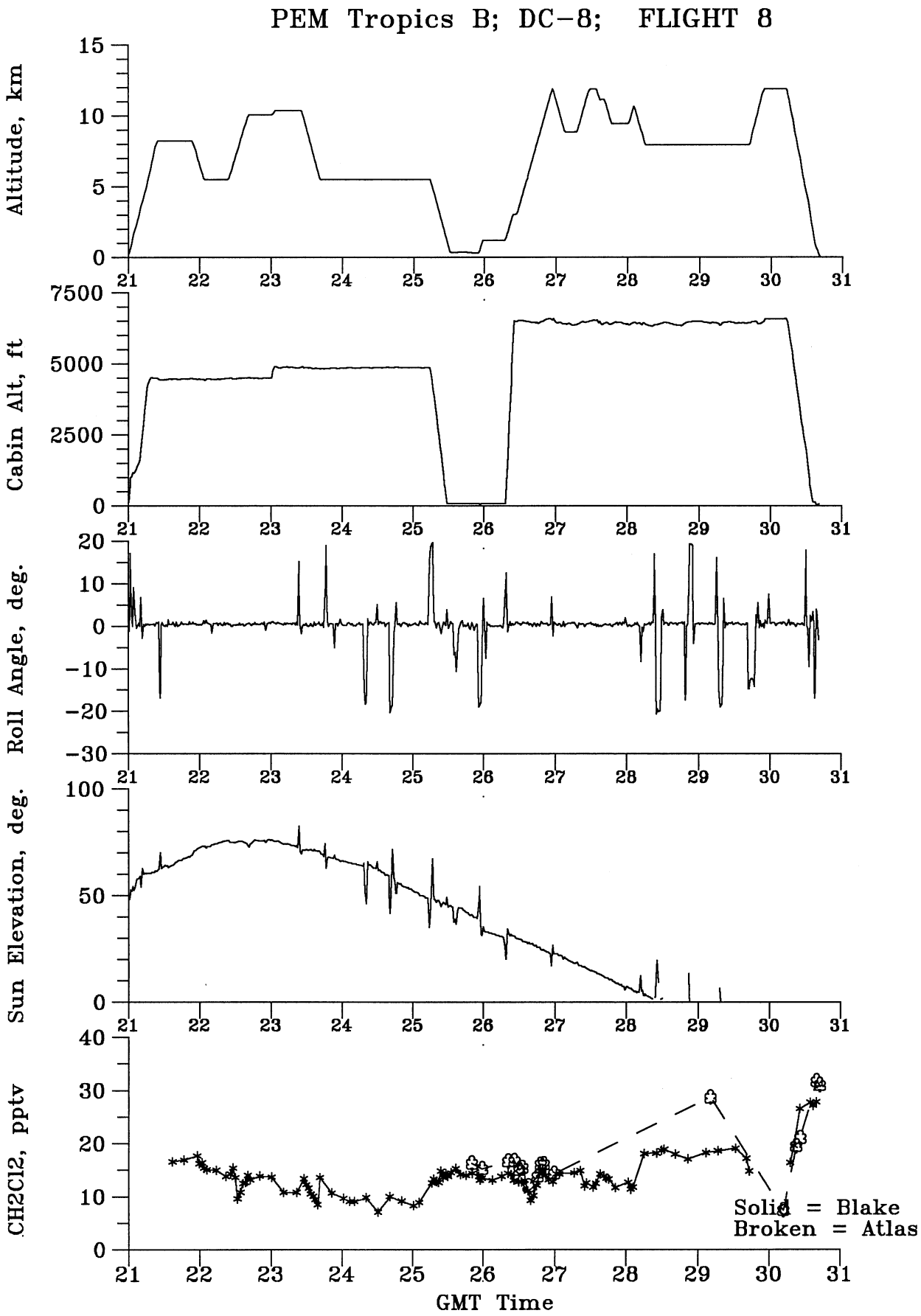

PEM Tropics B; DC-8; FLIGHT 8
H2O2, pptv
2000
1000
0
CH3OOH & CH3COCH3, pptv
2000
1500
1000
500
0
Solid - CH3OOH
Broken - CH3COCH3
HO2, pptv
20
15
10
5
0
BE7, fci/scm
1000
500
0
CH2O, pptv
400
200
0
21
22
23
24
25
26
27
28
29
30
31
GMT Time


PEM Tropics B; DC-8; FLIGHT 8
NO3-, pptv
75
50
25
0
Cl-, pptv
1000
500
0
CH3SO3-, pptv
9
6
3
0
SO4-, pptv
200
100
0
NH4+, pptv
300
200
100
0
21
22
23
24
25
26
27
28
29
30
31
GMT Time

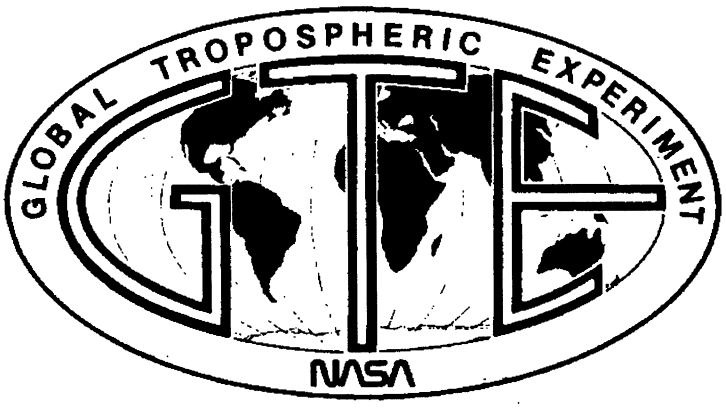

PEM Tropics B; DC-8; FLIGHT 8
CH3ONO2, pptv
Solid - Blake
Broken - Atlas
Solid - Square Singh
C2H5ONO2, pptv
Solid = Blake
Broken = Atlas
i-C3H7ONO2, pptv
Solid = Blake
Broken = Atlas
n-C3H7ONO2, pptv
Solid = Blake
Broken = Atlas
PAN, pptv
GMT Time


PEM Tropics B; DC-8; FLIGHT 8
CH3CFCl2, pptv
15
10
5
Solid = Blake
Broken = Atlas
CH3CF2Cl, pptv
15
10
5
Solid = Blake
Broken = Atlas
CHF2Cl, pptv
150
140
130
120
Solid = Blake
Broken = Atlas
CH2Br2, pptv
2.0
1.5
1.0
0.5
Solid = Blake
Broken = Atlas
CHBr3, pptv
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Solid = Blake
Broken = Atlas
21 22 23 24 25 26 27 28 29 30 31
GMT Time


PEM Tropics B; DC-8; FLIGHT 8
J(O3), sec-1
1.0E-4
5.0E-5
0.0E+0
J(NO2), sec-1
1.8E-2
1.2E-2
6.0E-3
0.0E+0
J(H2O2), sec-1
1.5E-5
1.0E-5
5.0E-6
0.0E+0
J(NO2)z, sec-1
1.2E-2
8.0E-3
4.0E-3
0.0E+0
J(NO2)n, sec-1
1.6E-2
1.2E-2
8.0E-3
4.0E-3
0.0E+0
21 22 23 24 25 26 27 28 29 30 31
GMT Time


PEM Tropics B; DC-8; FLIGHT 8
Altitude, km
Cabin Alt, ft
Roll Angle, deg.
Sun Elevation, deg.
CH2Cl2, pptv
GMT Time
Solid = Blake
Broken = Atlas

PLOTS OF FINAL CHEMICAL DATA



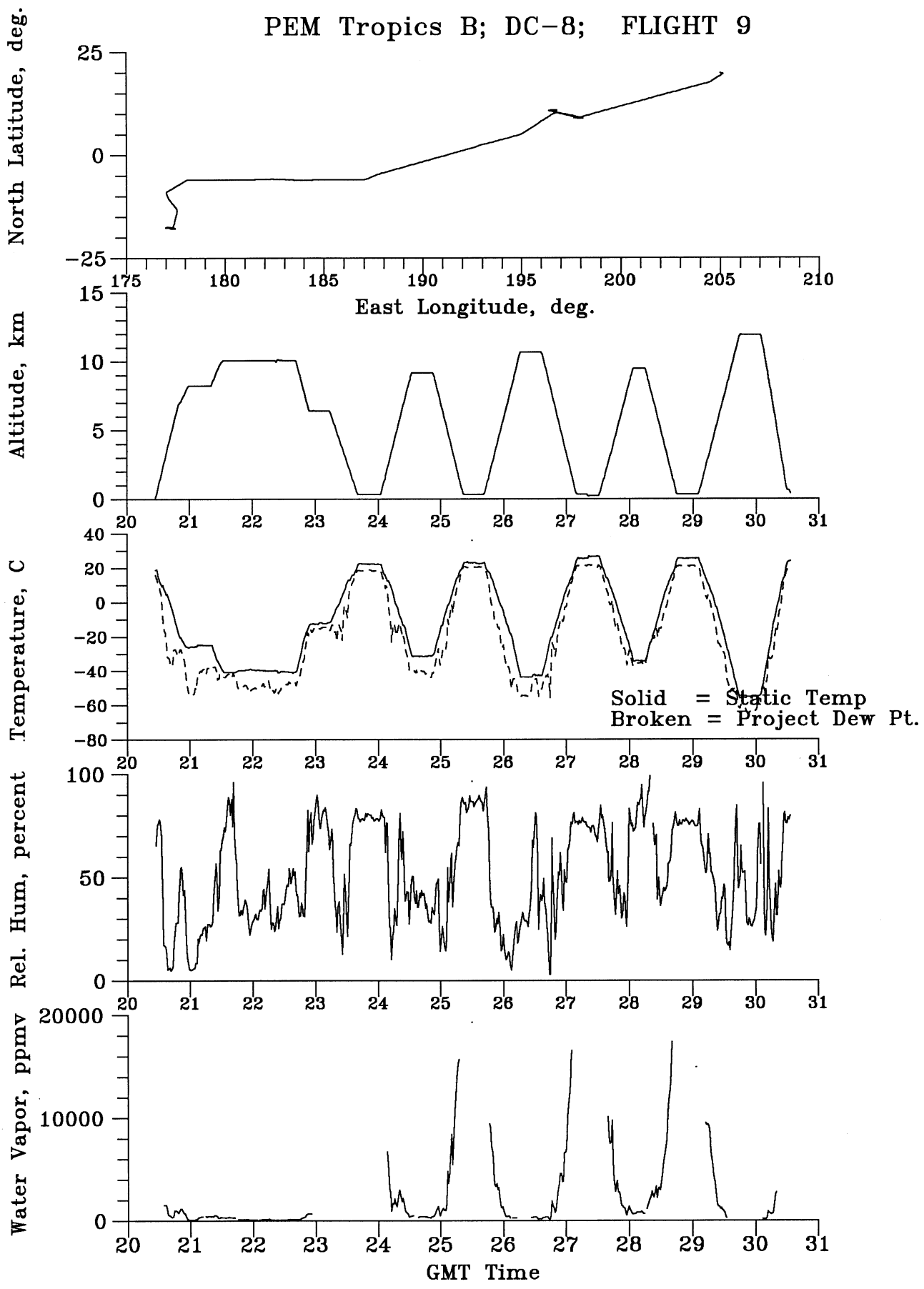
PEM-TROPICS B

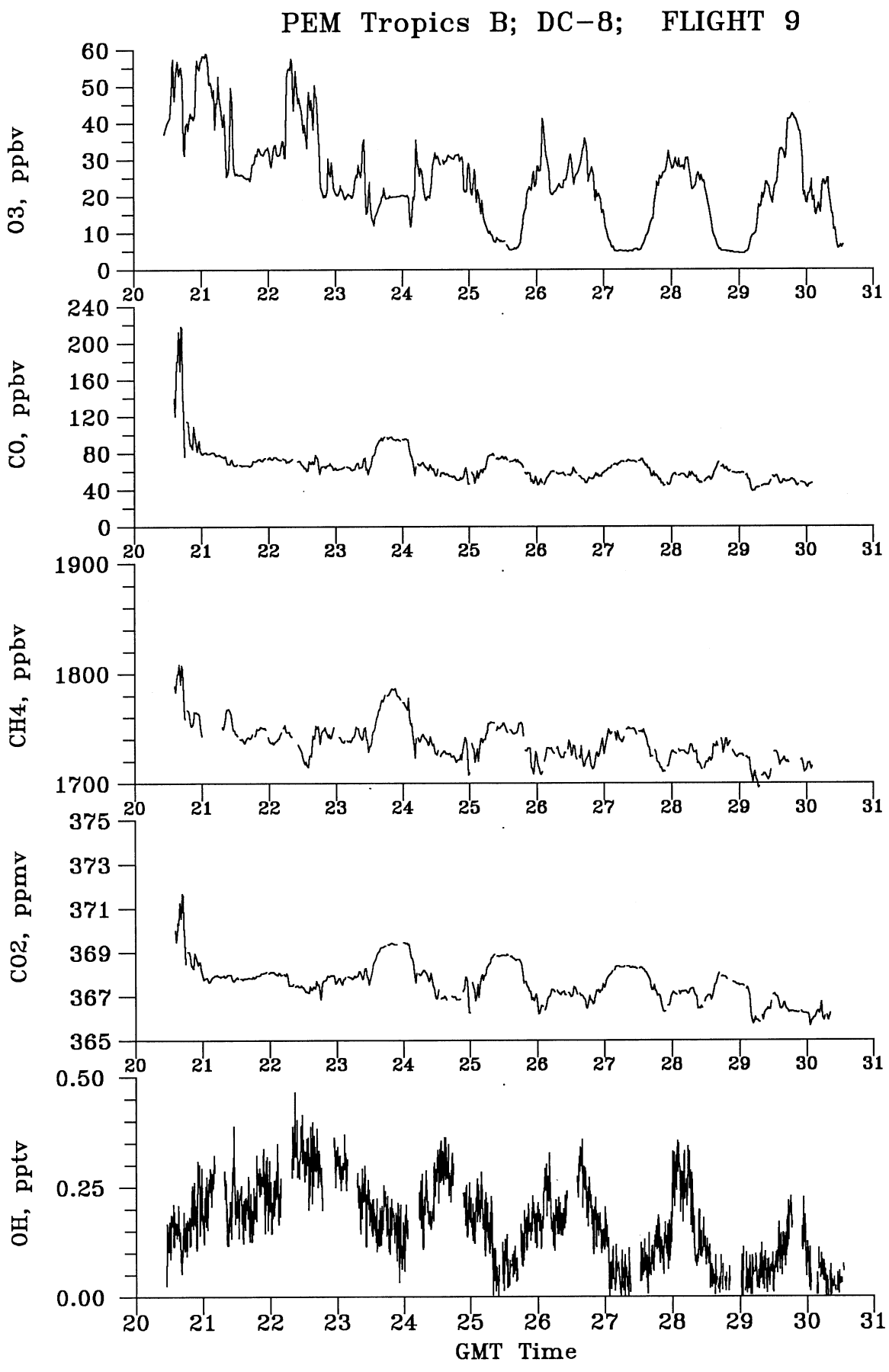
Flight 9D

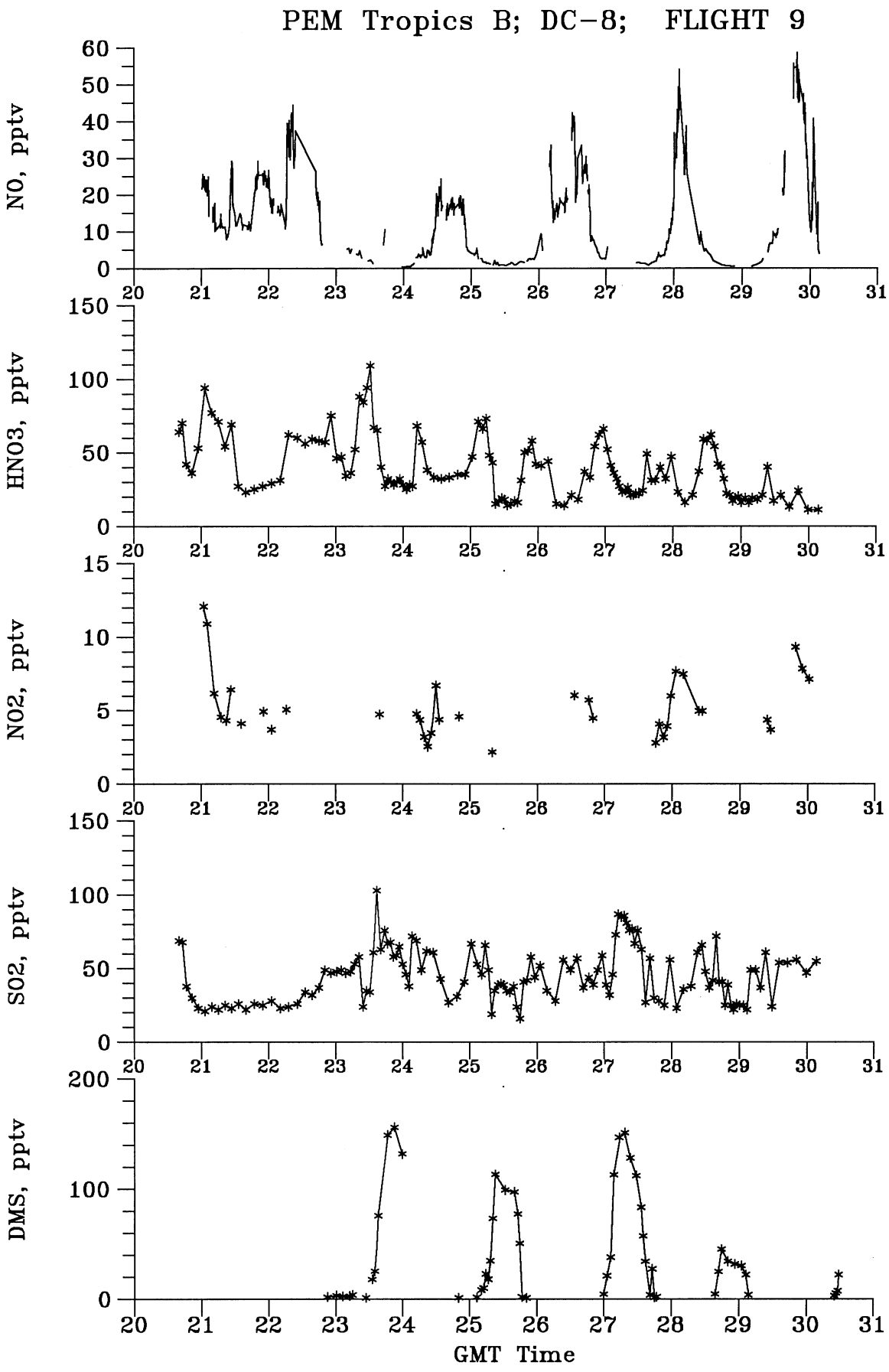
Transit: Hilo to Fiji

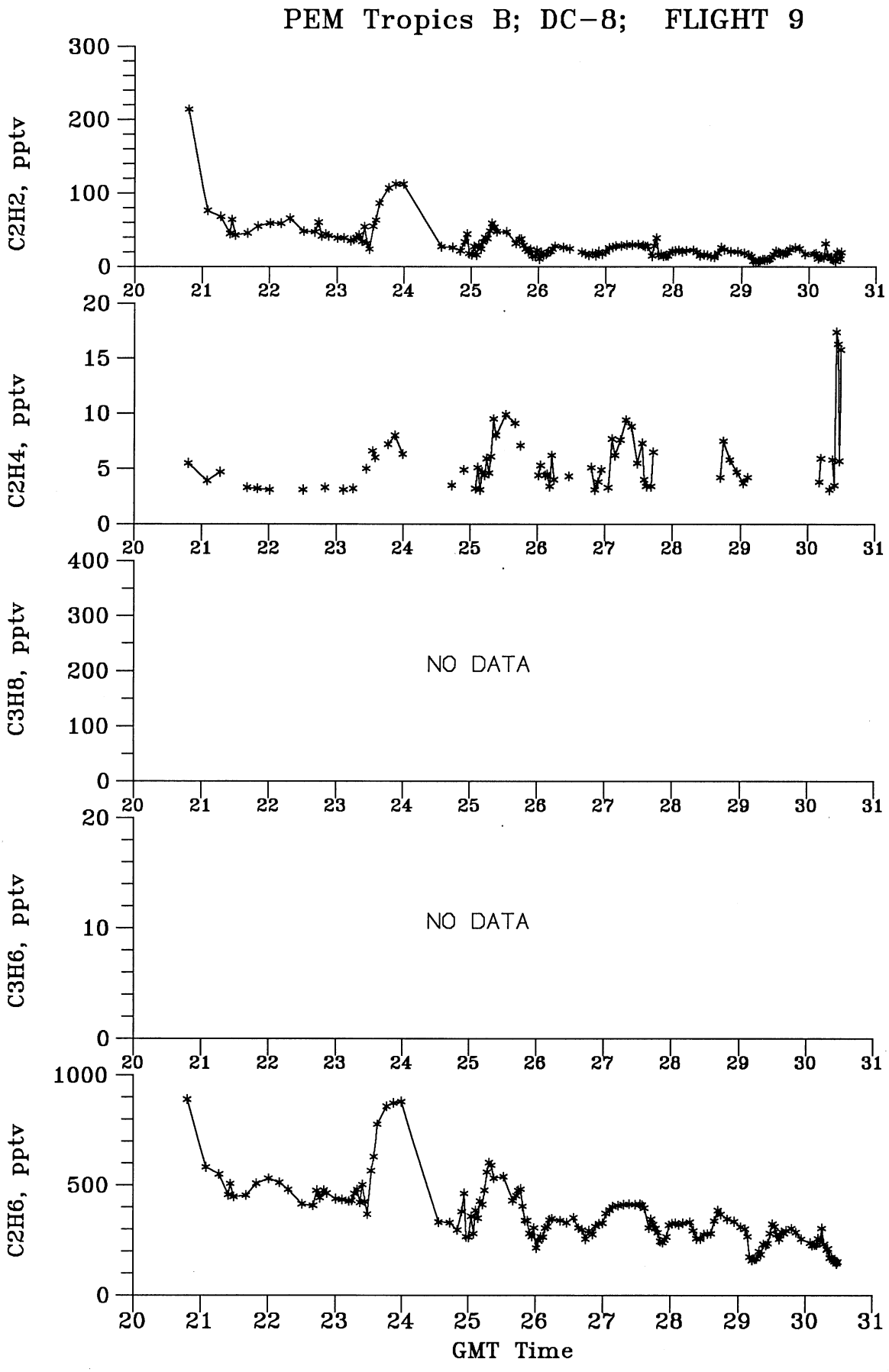
Equatorial Photochemistry

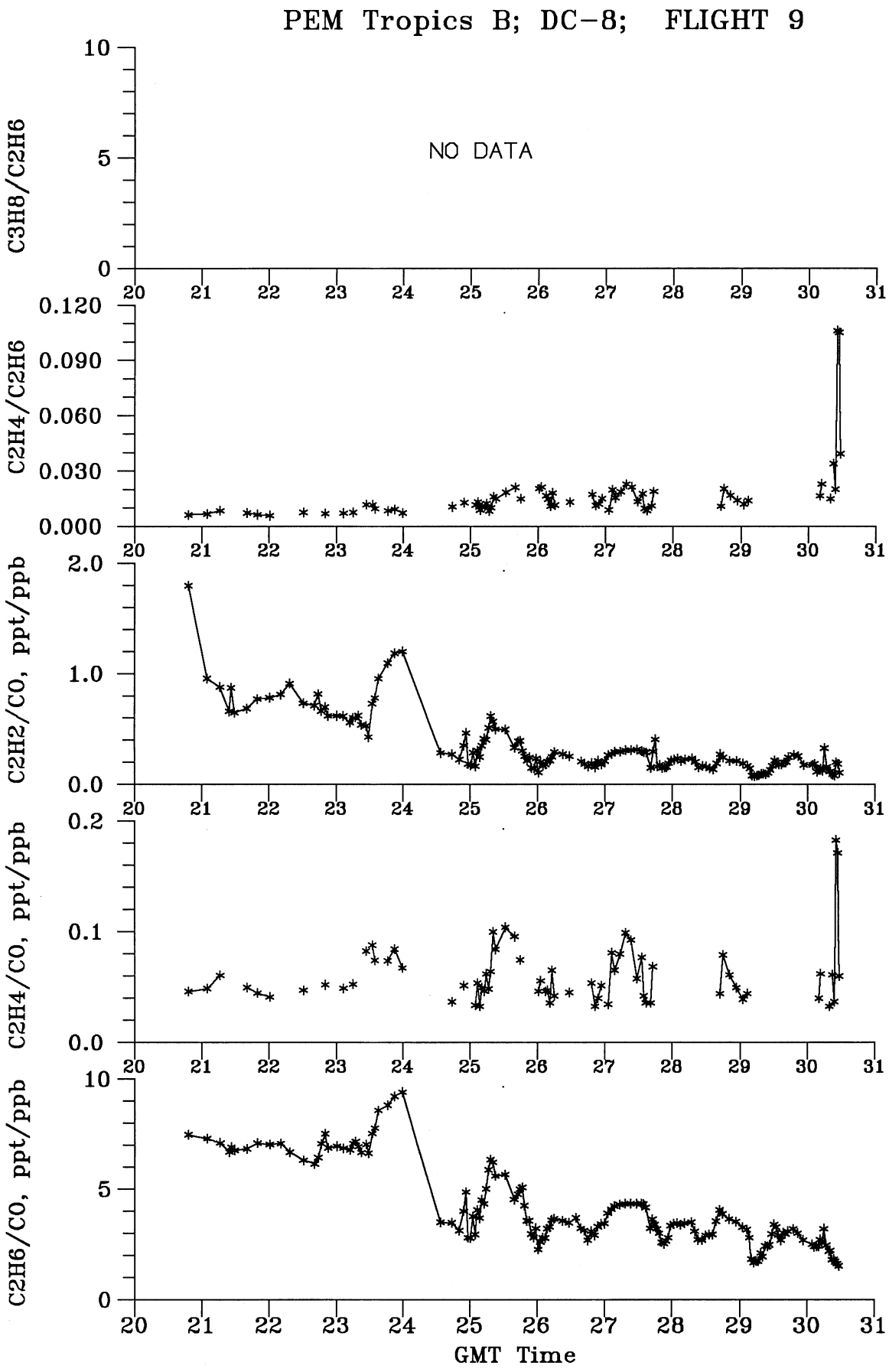
March 17, 1999

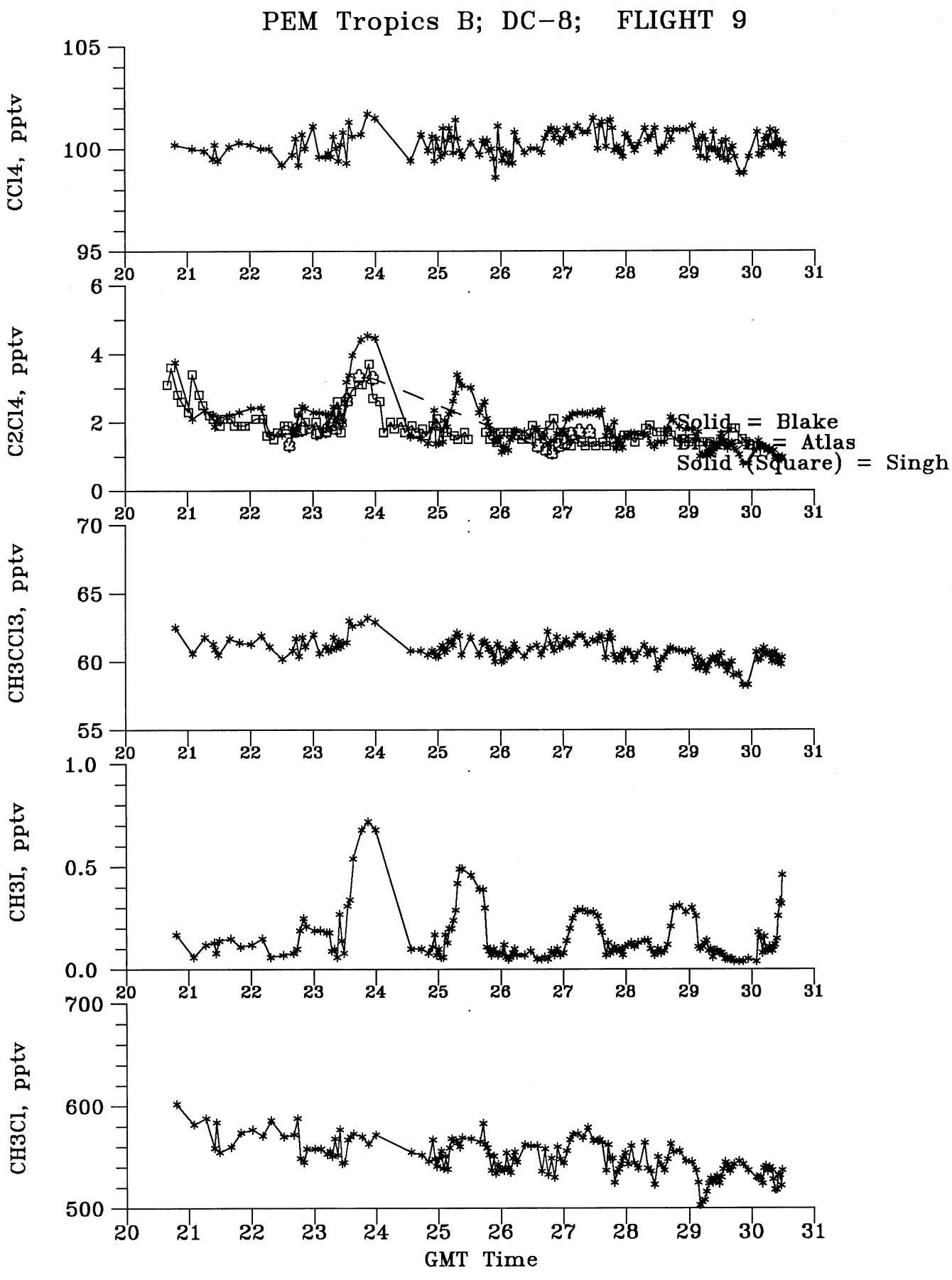

PEM Tropics B; DC-8; FLIGHT 9
North Latitude, deg.
25
0
-25
175
180
185
190
195
200
205
210
East Longitude, deg.
Altitude, km
15
10
5
0
20
21
22
23
24
25
26
27
28
29
30
31
Temperature, C
40
20
0
-20
-40
-60
-80
Solid = Static Temp
Broken = Project Dew Pt.
Rel. Hum, percent
100
50
0
Water Vapor, ppmv
20000
10000
0
GMT Time

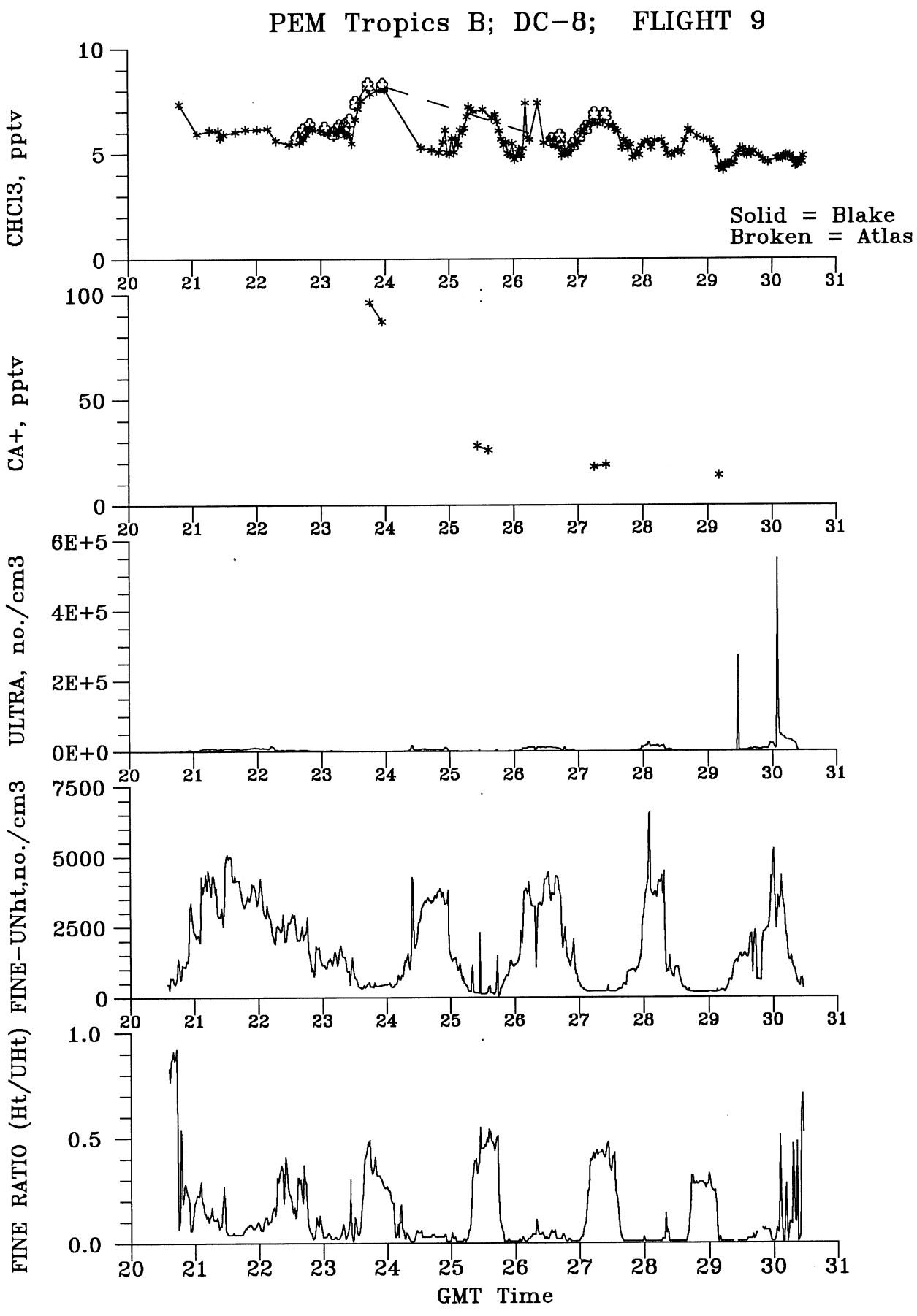

PEM Tropics B; DC-8; FLIGHT 9
O3, ppbv
60
50
40
30
20
10
0
CO, ppbv
240
200
160
120
80
40
0
CH4, ppbv
1900
1800
1700
CO2, ppmv
375
373
371
369
367
365
OH, pptv
0.50
0.25
0.00
20
21
22
23
24
25
26
27
28
29
30
31
GMT Time

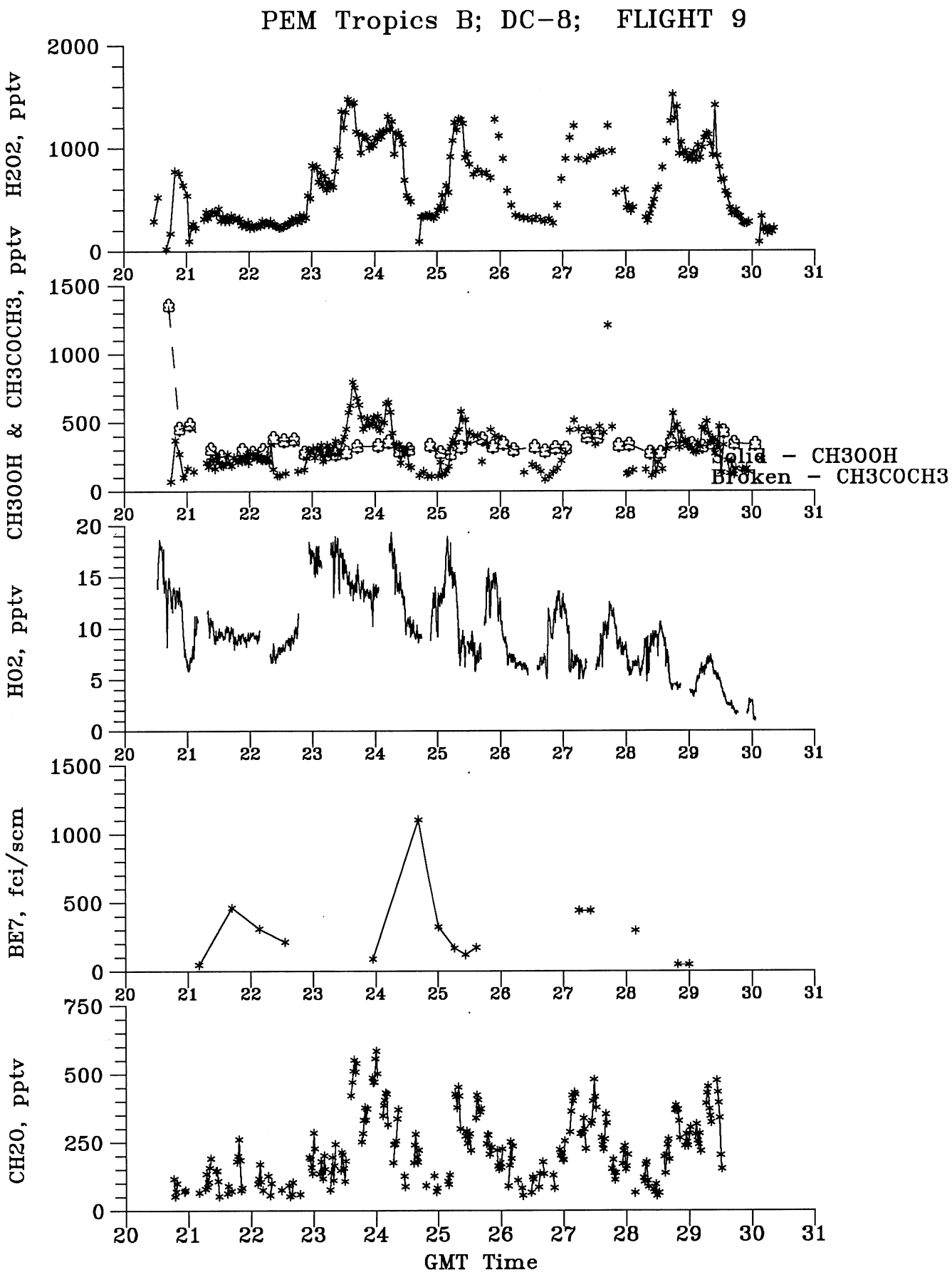

PEM Tropics B; DC-8; FLIGHT 9
NO, pptv
HNO3, pptv
NO2, pptv
SO2, pptv
DMS, pptv
GMT Time

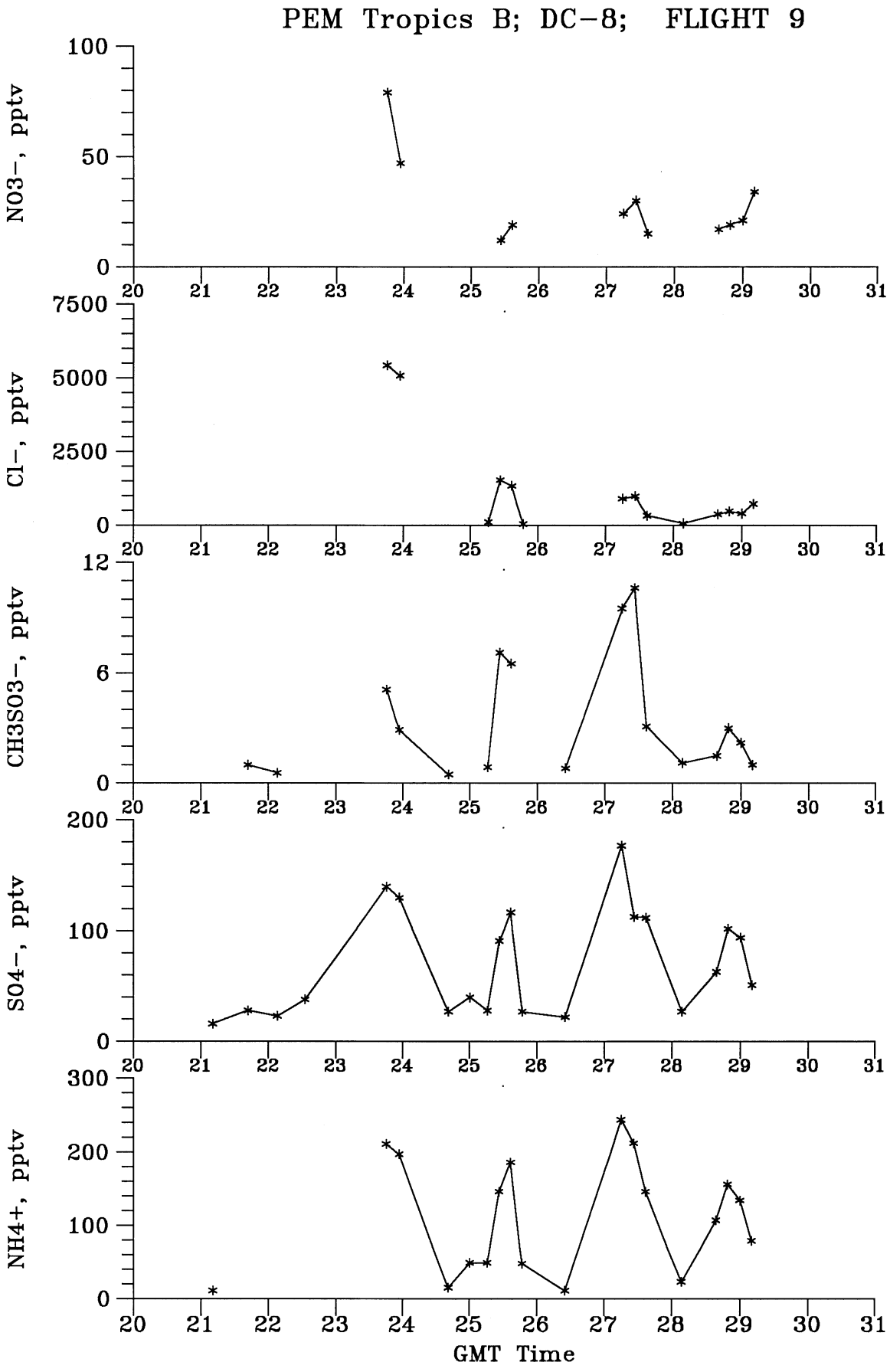

PEM Tropics B; DC-8; FLIGHT 9
C2H2, pptv
300
200
100
0
C2H4, pptv
20
15
10
5
0
C3H8, pptv
400
300
200
100
0
NO DATA
C3H6, pptv
20
10
0
NO DATA
C2H6, pptv
1000
500
0
20 21 22 23 24 25 26 27 28 29 30 31
GMT Time

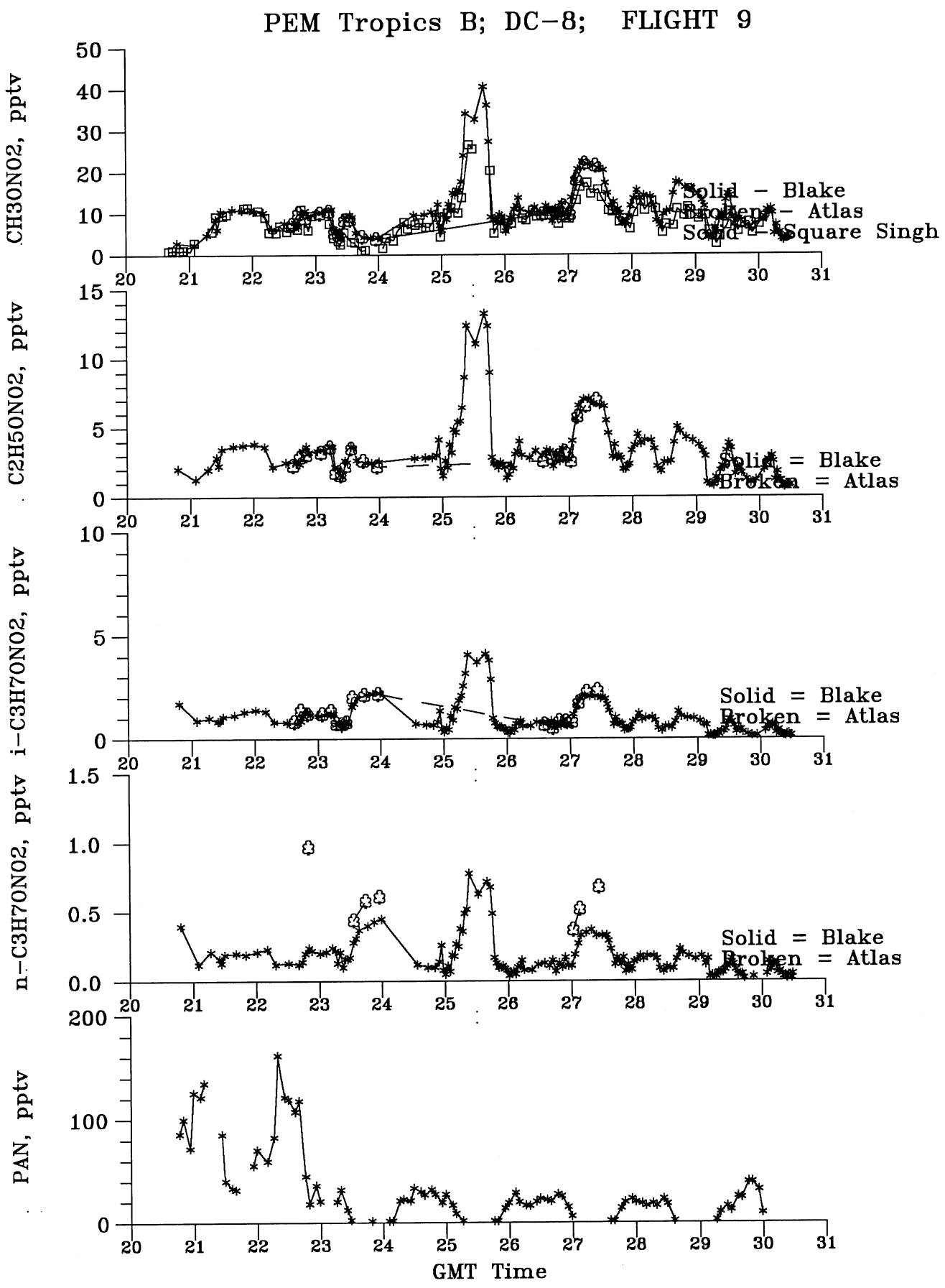

PEM Tropics B; DC-8; FLIGHT 9
NO DATA
C3H8/C2H6
C2H4/C2H6
C2H2/CO, ppt/ppb
C2H4/CO, ppt/ppb
C2H6/CO, ppt/ppb
GMT Time

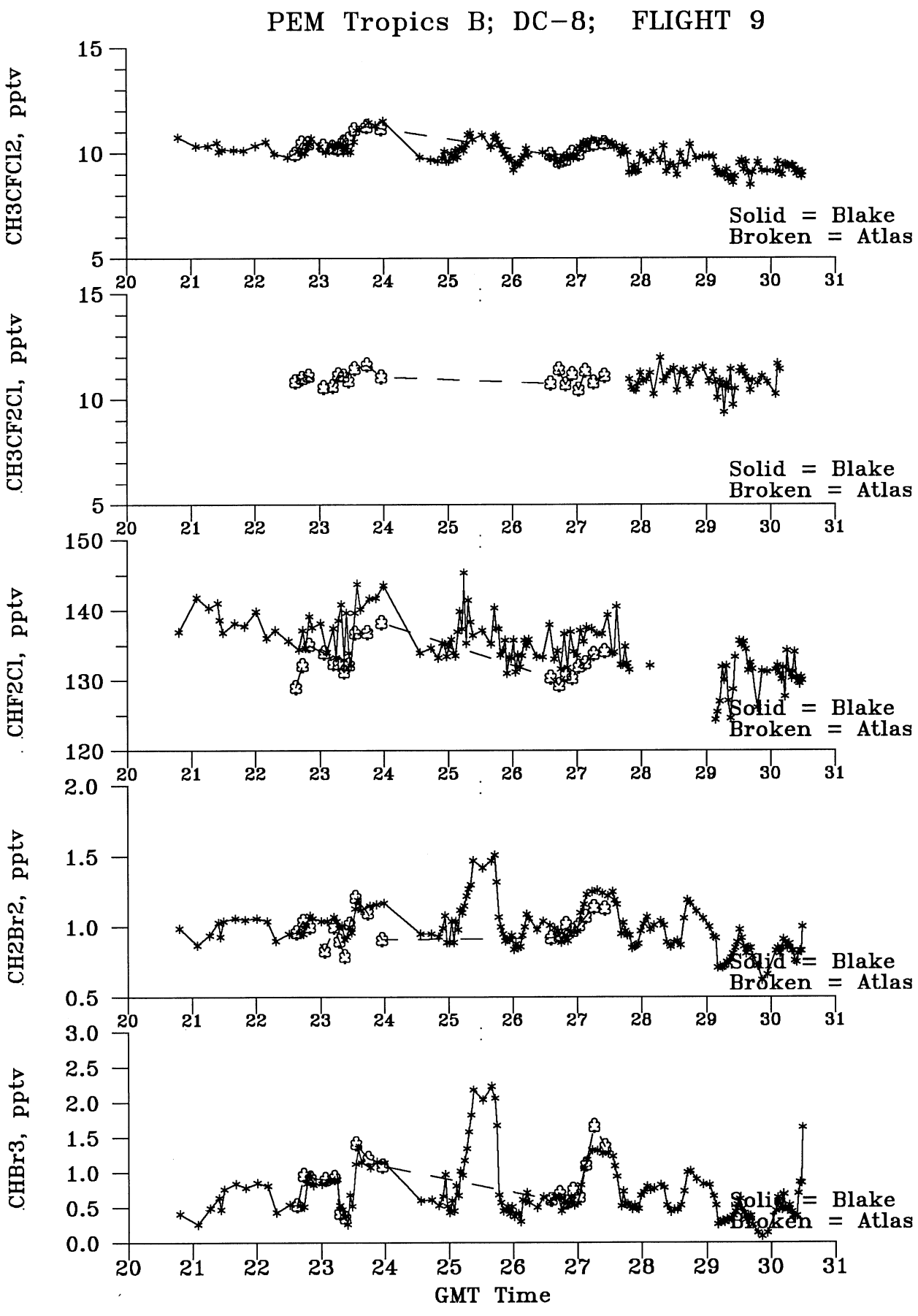

PEM Tropics B; DC-8; FLIGHT 9
CCl4, pptv
105
100
95
C2Cl4, pptv
6
4
2
0
Solid = Blake
= Atlas
Solid (Square) = Singh
CH3CCl3, pptv
70
65
60
55
CH3I, pptv
1.0
0.5
0.0
CH3Cl, pptv
700
600
500
20
21
22
23
24
25
26
27
28
29
30
31
GMT Time

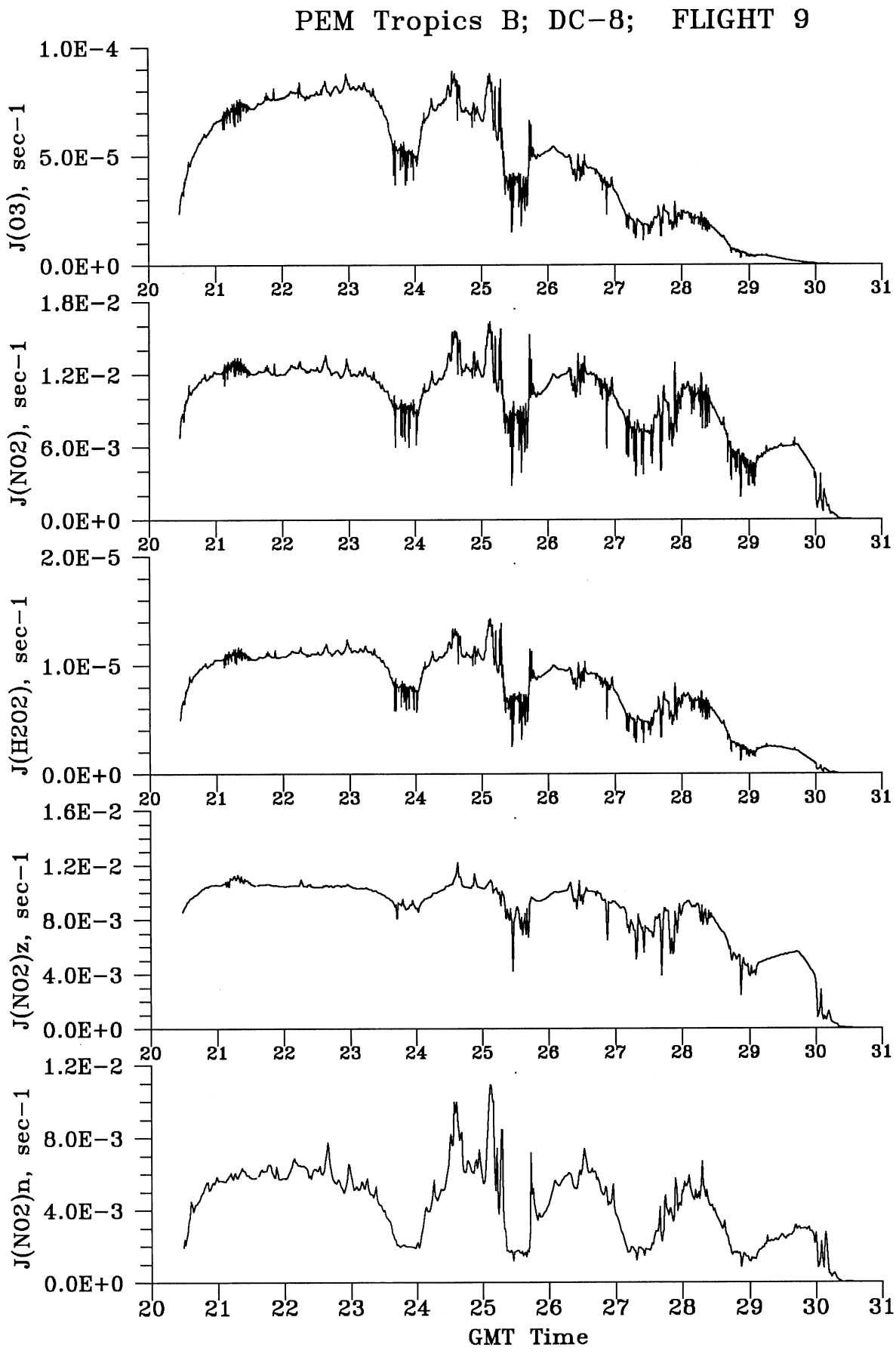

PEM Tropics B; DC-8; FLIGHT 9
CHCl3, pptv
Solid = Blake
Broken = Atlas
CA+, pptv
ULTRA, no./cm3
FINE-UNht,no./cm3
FINE RATIO (Ht/UHt)
GMT Time

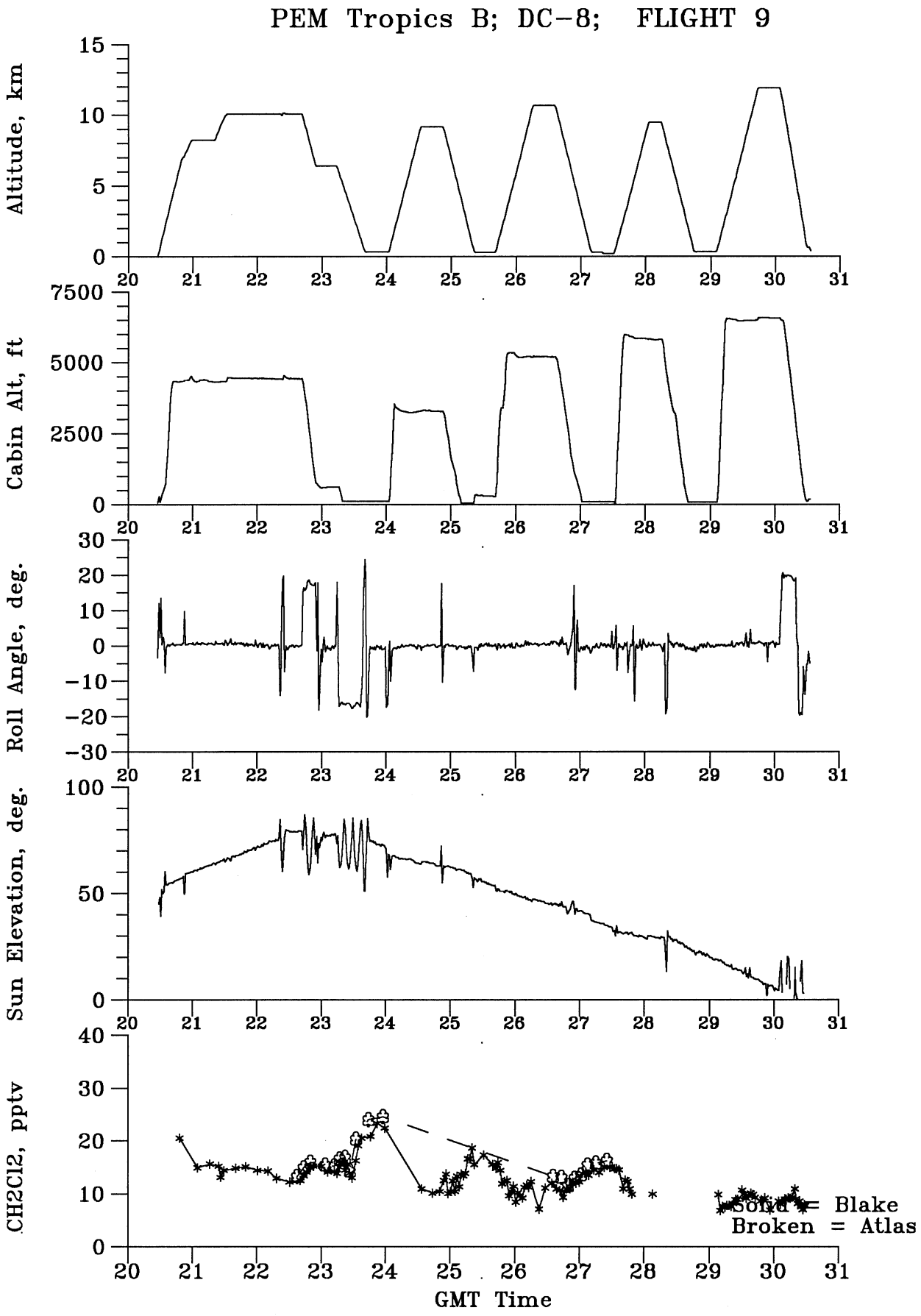

PEM Tropics B; DC-8; FLIGHT 9
H2O2, pptv
CH3OOH & CH3COCH3, pptv
Solid - CH3OOH
Broken - CH3COCH3
HO2, pptv
BE7, fci/scm
CH2O, pptv
GMT Time


PEM Tropics B; DC-8; FLIGHT 9
NO3-, pptv
100
50
0
Cl-, pptv
7500
5000
2500
0
CH3SO3-, pptv
12
6
0
SO4-, pptv
200
100
0
NH4+, pptv
300
200
100
0
20 21 22 23 24 25 26 27 28 29 30 31
GMT Time

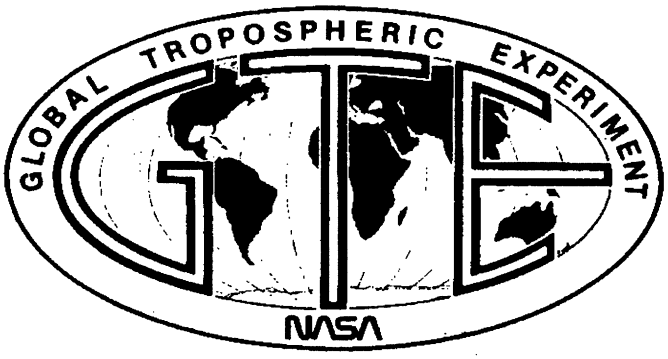

PEM Tropics B; DC-8; FLIGHT 9
CH3ONO2, pptv
C2H5ONO2, pptv
i-C3H7ONO2, pptv
n-C3H7ONO2, pptv
PAN, pptv
GMT Time
Solid - Blake
Broken - Atlas
Solid - Square Singh
Solid = Blake
Broken = Atlas


PEM Tropics B; DC-8; FLIGHT 9
CH3CFCl2, pptv
15
10
5
Solid = Blake
Broken = Atlas
CH3CF2Cl, pptv
15
10
5
Solid = Blake
Broken = Atlas
CHF2Cl, pptv
150
140
130
120
Solid = Blake
Broken = Atlas
CH2Br2, pptv
2.0
1.5
1.0
0.5
Solid = Blake
Broken = Atlas
CHBr3, pptv
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Solid = Blake
Broken = Atlas
20 21 22 23 24 25 26 27 28 29 30 31
GMT Time


PEM Tropics B; DC-8; FLIGHT 9
J(O3), sec-1
1.0E-4
5.0E-5
0.0E+0
J(NO2), sec-1
1.8E-2
1.2E-2
6.0E-3
0.0E+0
J(H2O2), sec-1
2.0E-5
1.0E-5
0.0E+0
J(NO2)z, sec-1
1.6E-2
1.2E-2
8.0E-3
4.0E-3
0.0E+0
J(NO2)n, sec-1
1.2E-2
8.0E-3
4.0E-3
0.0E+0
20 21 22 23 24 25 26 27 28 29 30 31
GMT Time


PEM Tropics B; DC-8; FLIGHT 9
Altitude, km
15
10
5
0
Cabin Alt, ft
7500
5000
2500
0
Roll Angle, deg.
30
20
10
0
−10
−20
−30
Sun Elevation, deg.
100
50
0
CH2Cl2, pptv
40
30
20
10
0
Solid = Blake
Broken = Atlas
20 21 22 23 24 25 26 27 28 29 30 31
GMT Time

PLOTS OF FINAL CHEMICAL DATA



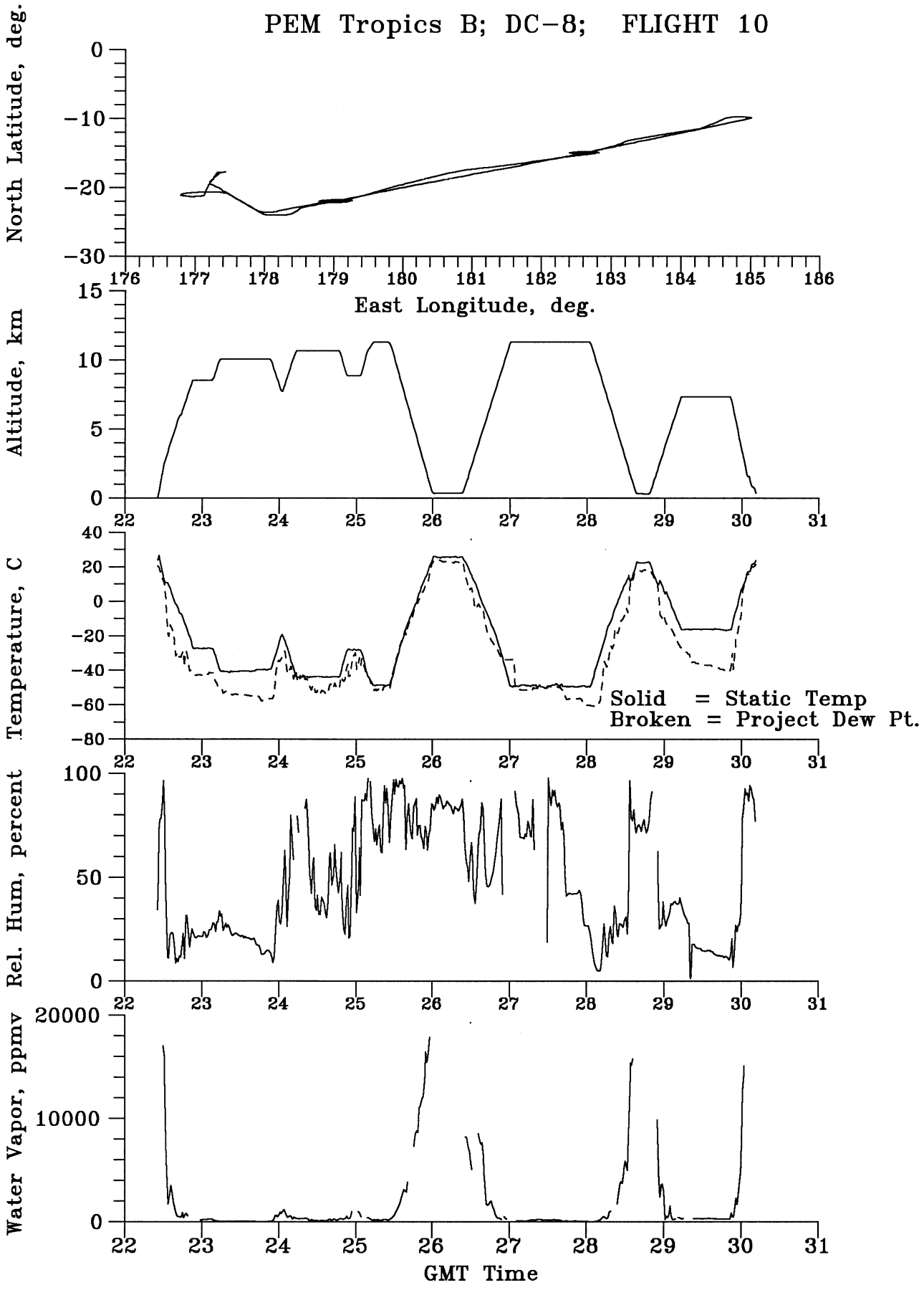
PEM-TROPICS B

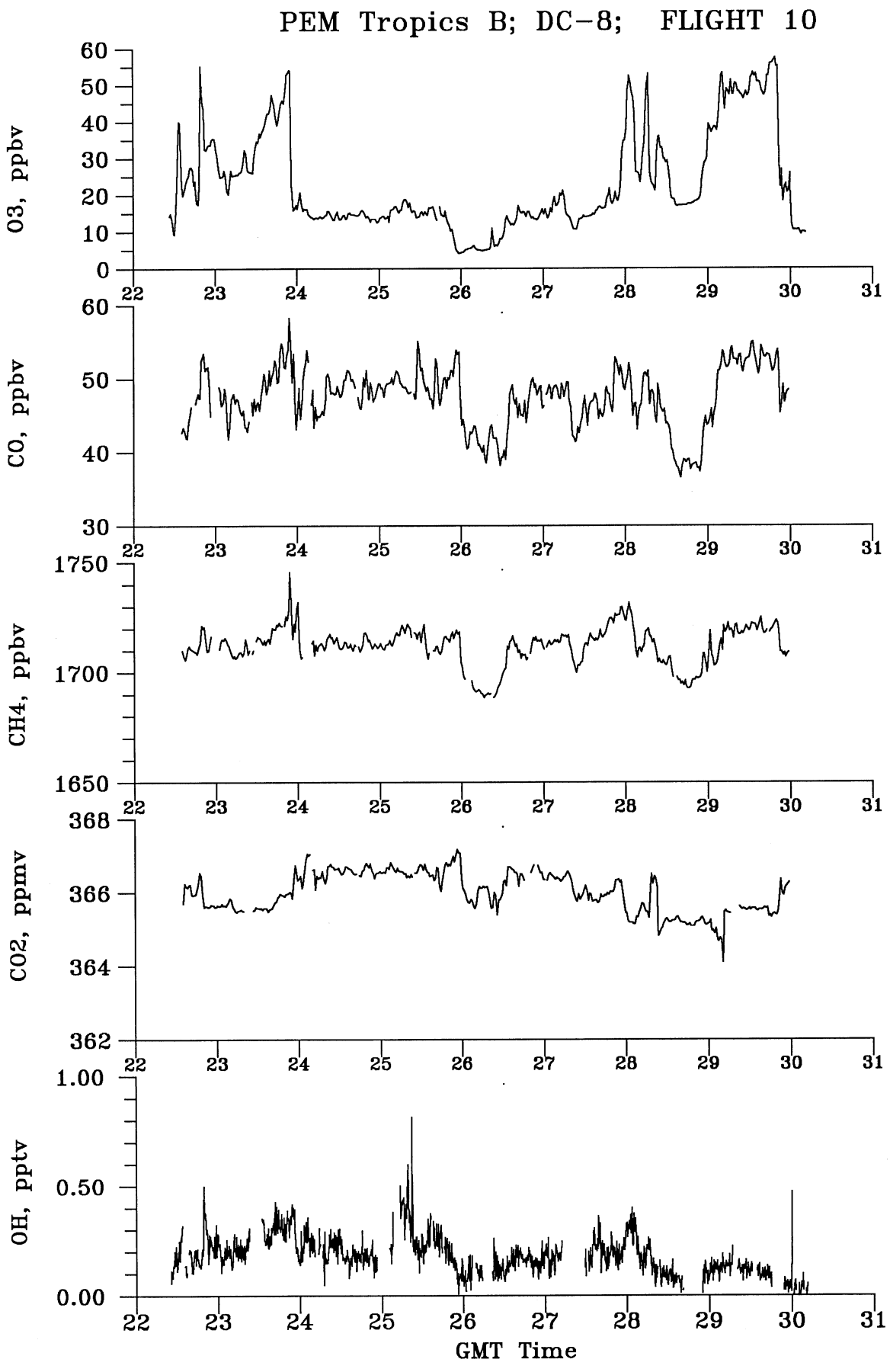
Flight 10D

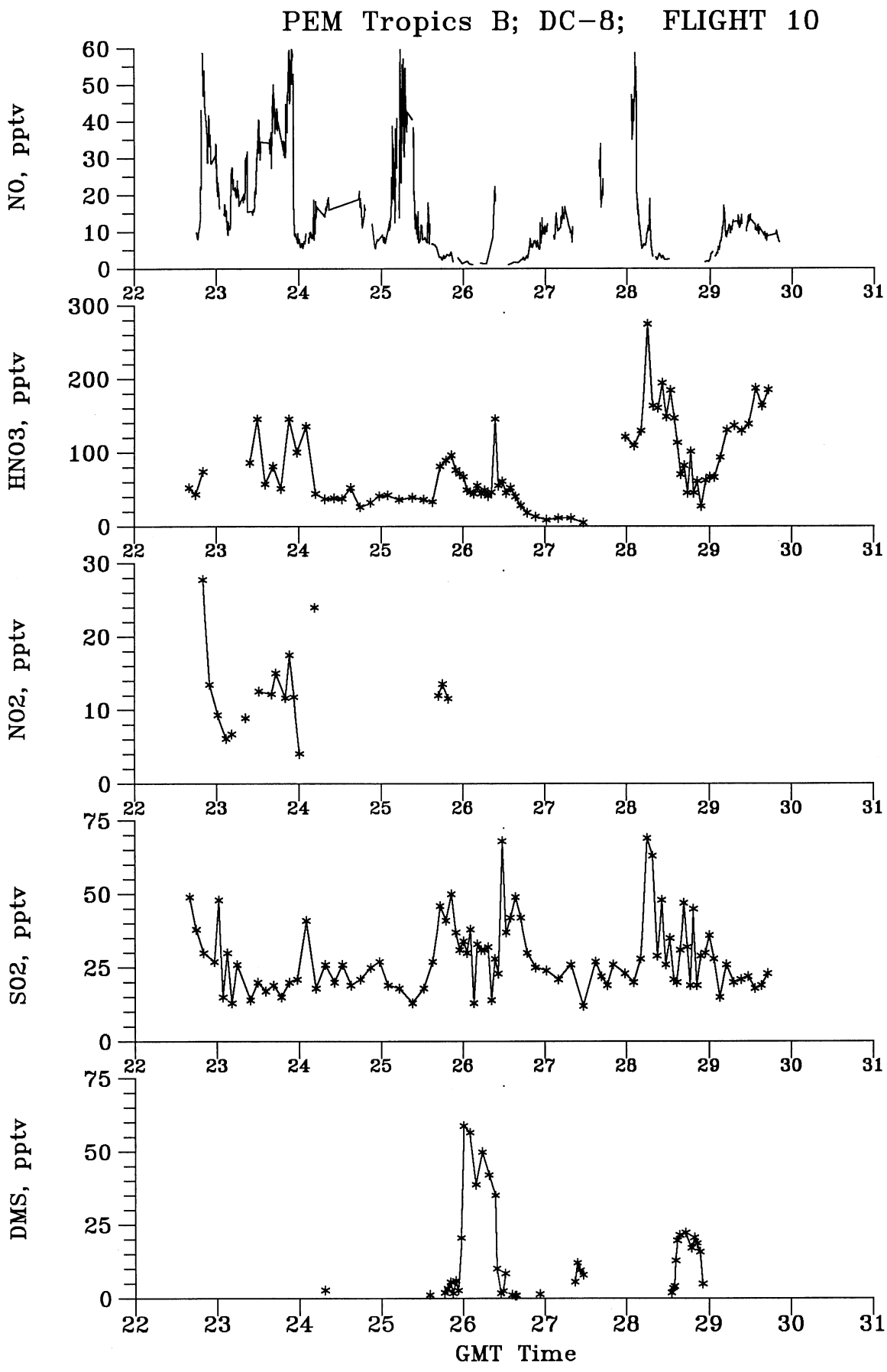
Local: Fiji No. 1

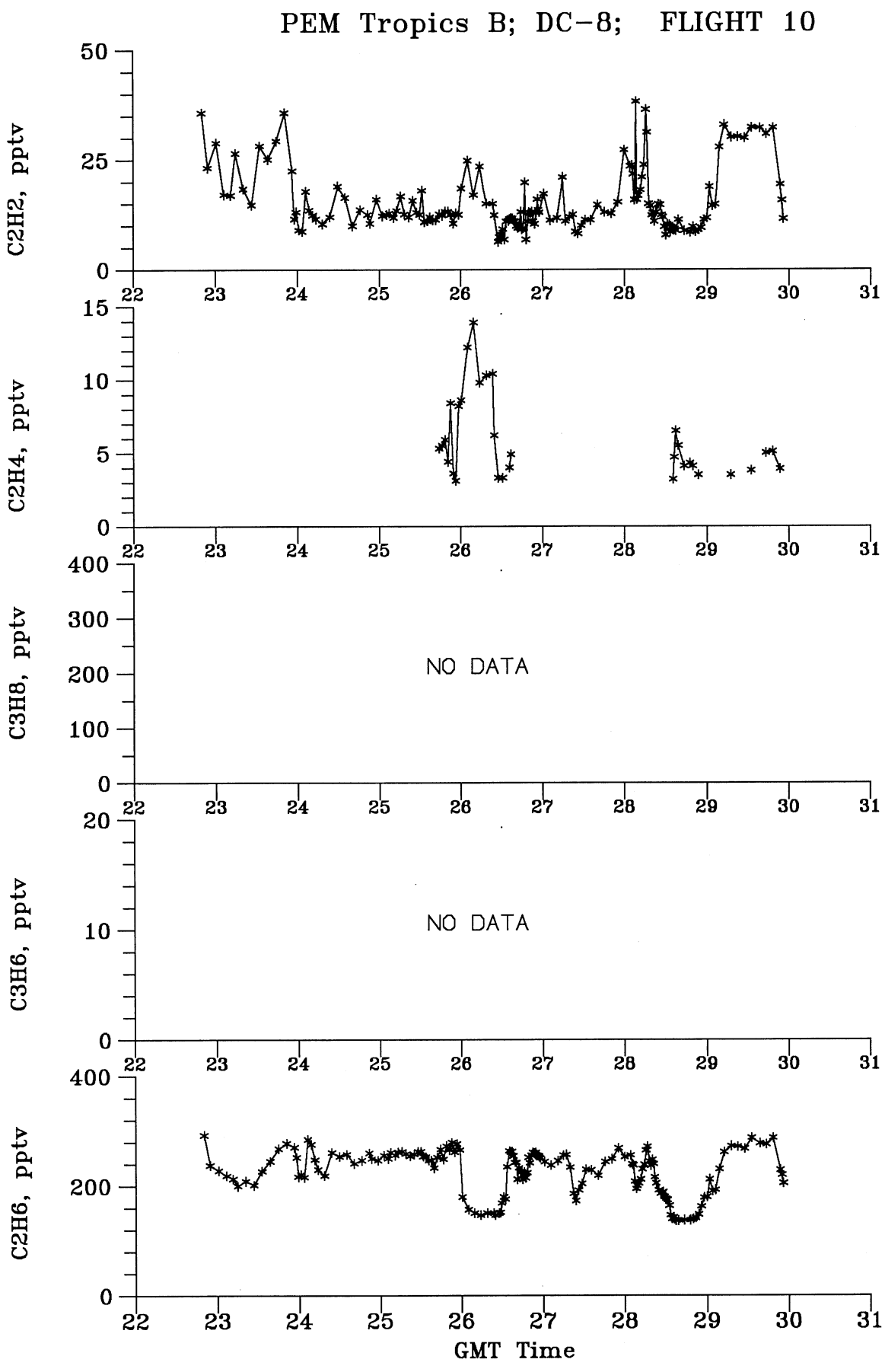
SPCZ

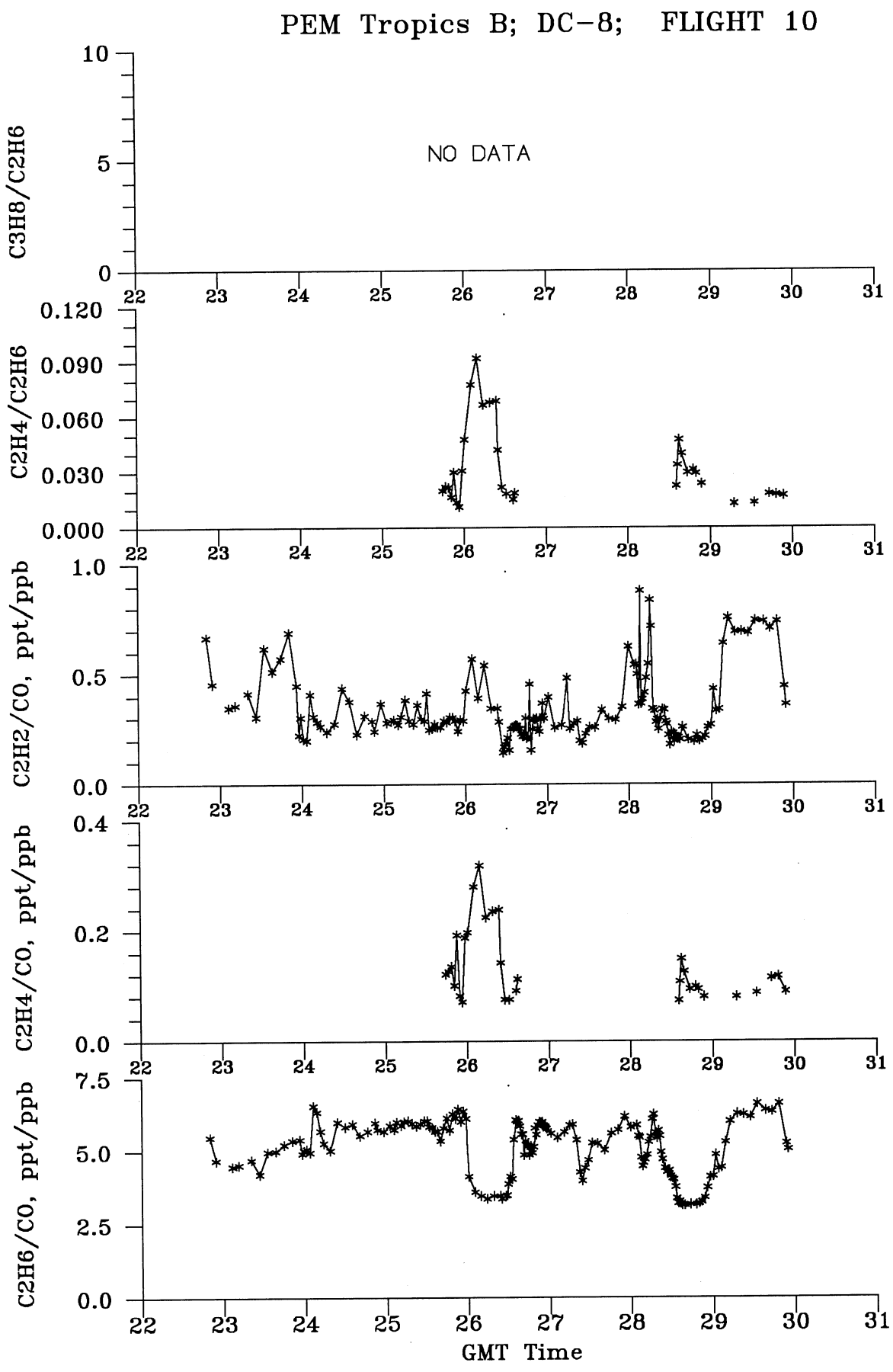
March 20, 1999

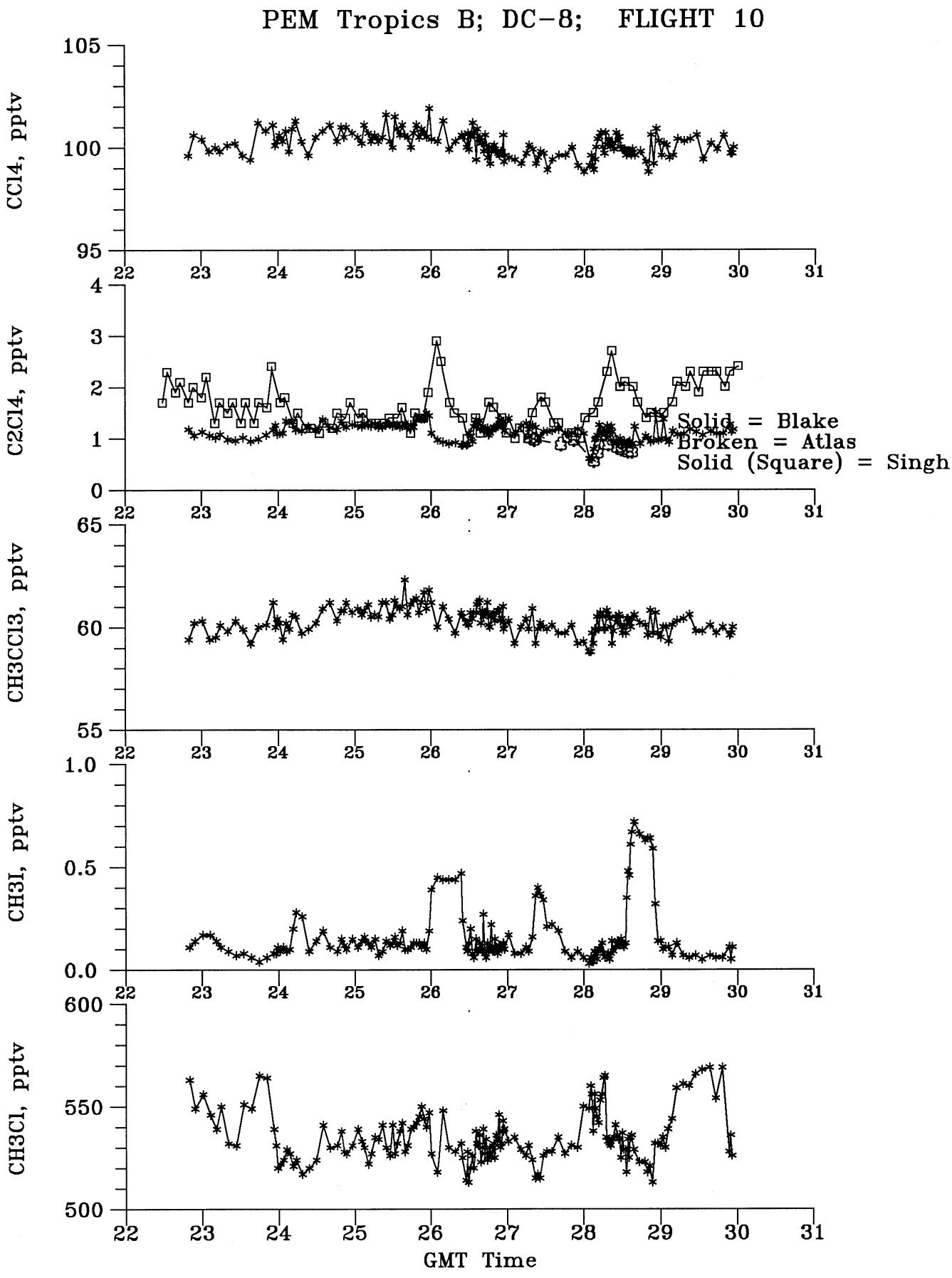

PEM Tropics B; DC-8; FLIGHT 10
North Latitude, deg.
0
-10
-20
-30
176 177 178 179 180 181 182 183 184 185 186
East Longitude, deg.
Altitude, km
15
10
5
0
22 23 24 25 26 27 28 29 30 31
Temperature, C
40
20
0
-20
-40
-60
-80
Solid = Static Temp
Broken = Project Dew Pt.
Rel. Hum, percent
100
50
0
Water Vapor, ppmv
20000
10000
0
GMT Time

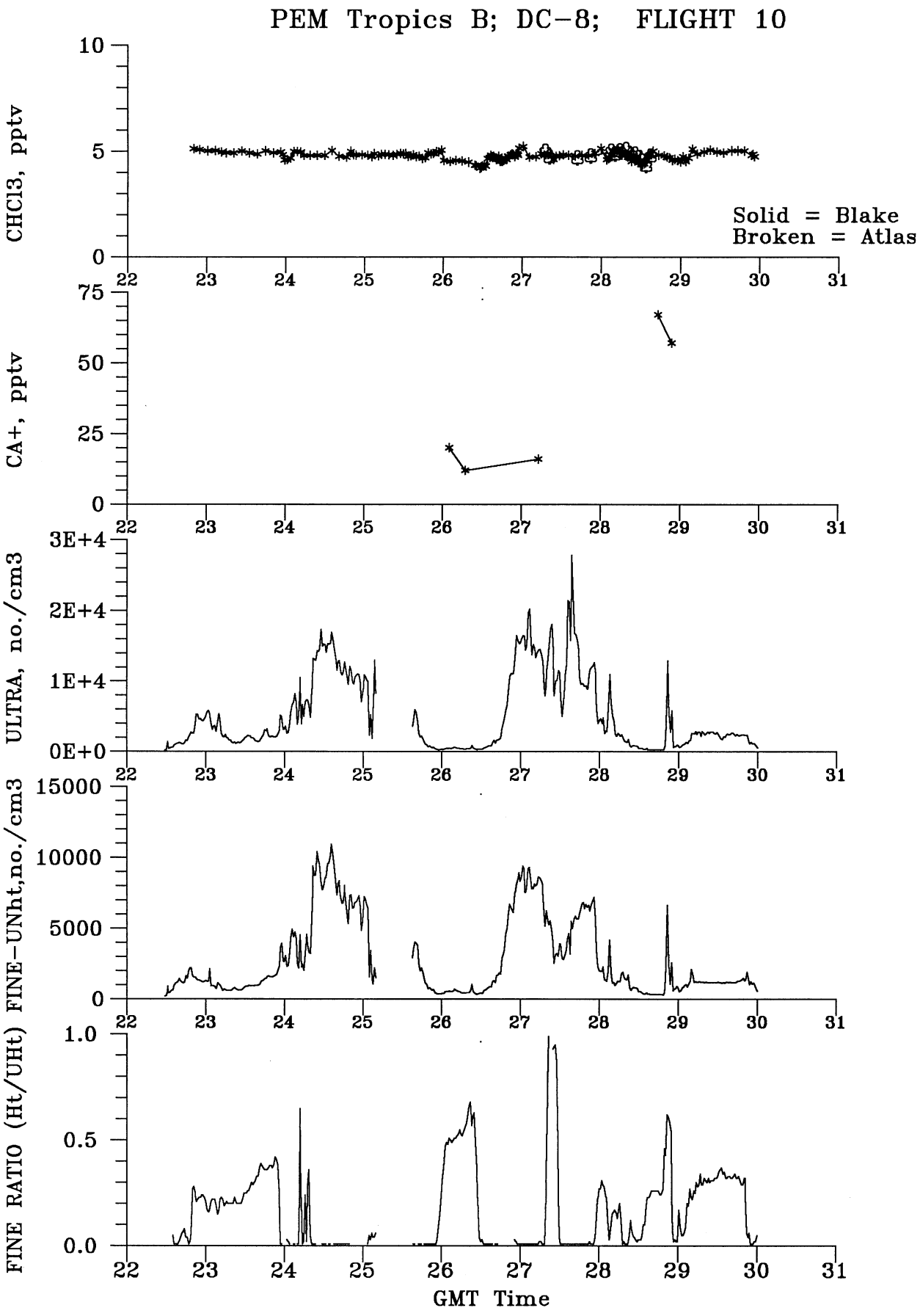

PEM Tropics B; DC-8; FLIGHT 10
O3, ppbv
60
50
40
30
20
10
0
CO, ppbv
60
50
40
30
CH4, ppbv
1750
1700
1650
CO2, ppmv
368
366
364
362
OH, pptv
1.00
0.50
0.00
22
23
24
25
26
27
28
29
30
31
GMT Time

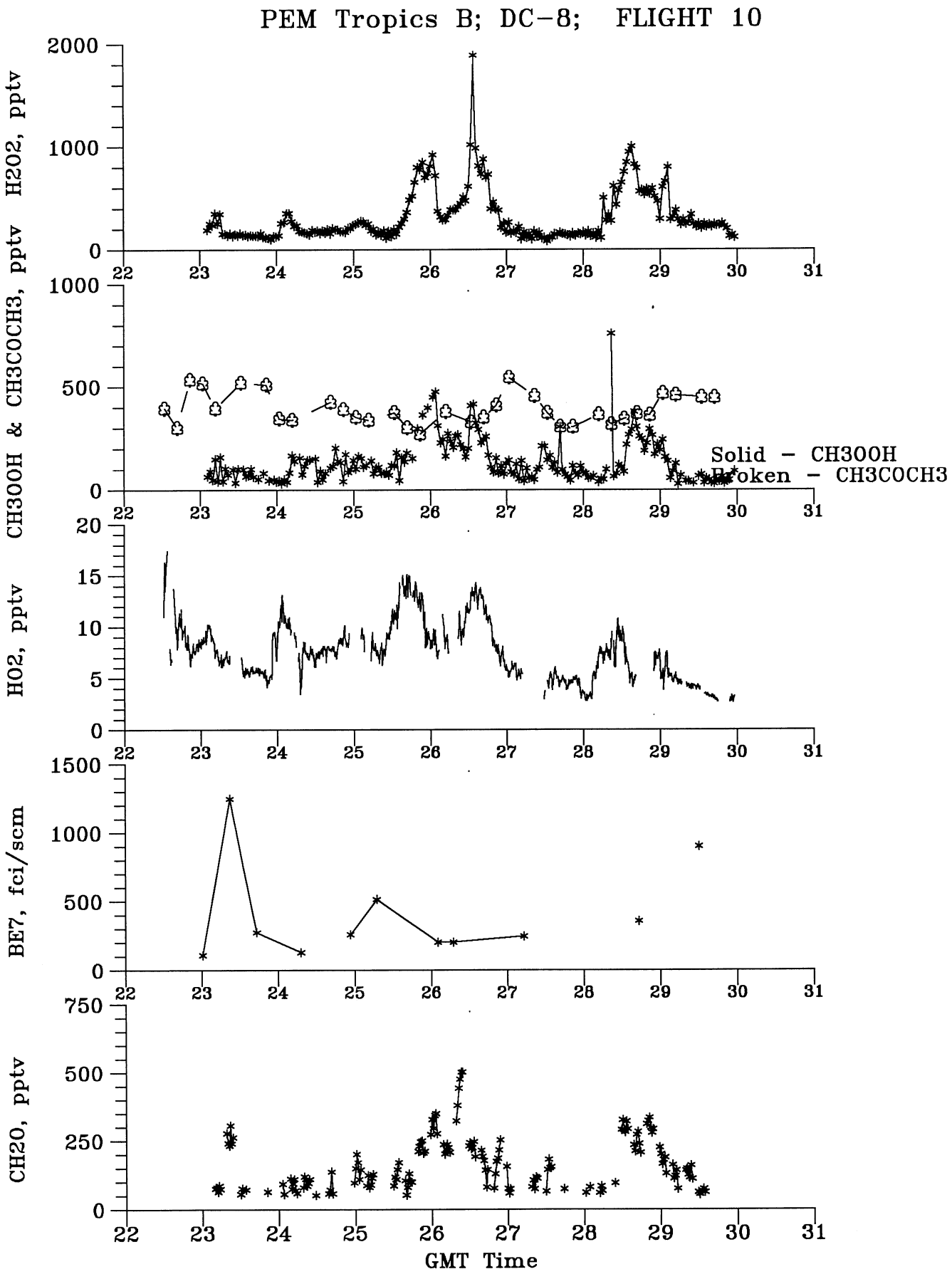

PEM Tropics B; DC-8; FLIGHT 10
NO, pptv
HNO3, pptv
NO2, pptv
SO2, pptv
DMS, pptv
GMT Time

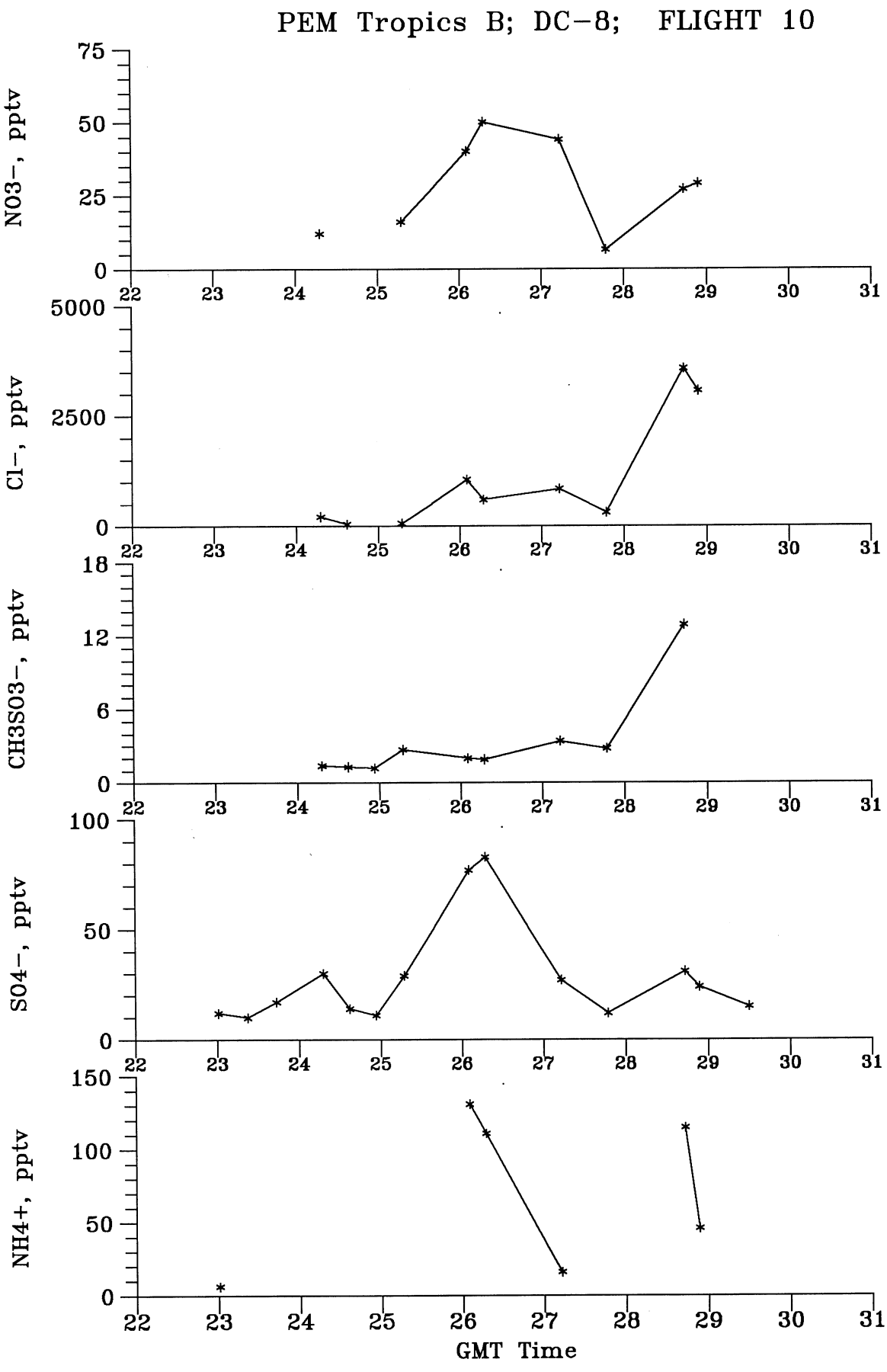

PEM Tropics B; DC-8; FLIGHT 10
C2H2, pptv
50
25
0
C2H4, pptv
15
10
5
0
C3H8, pptv
400
300
200
100
0
NO DATA
C3H6, pptv
20
10
0
NO DATA
C2H6, pptv
400
200
0
22
23
24
25
26
27
28
29
30
31
GMT Time

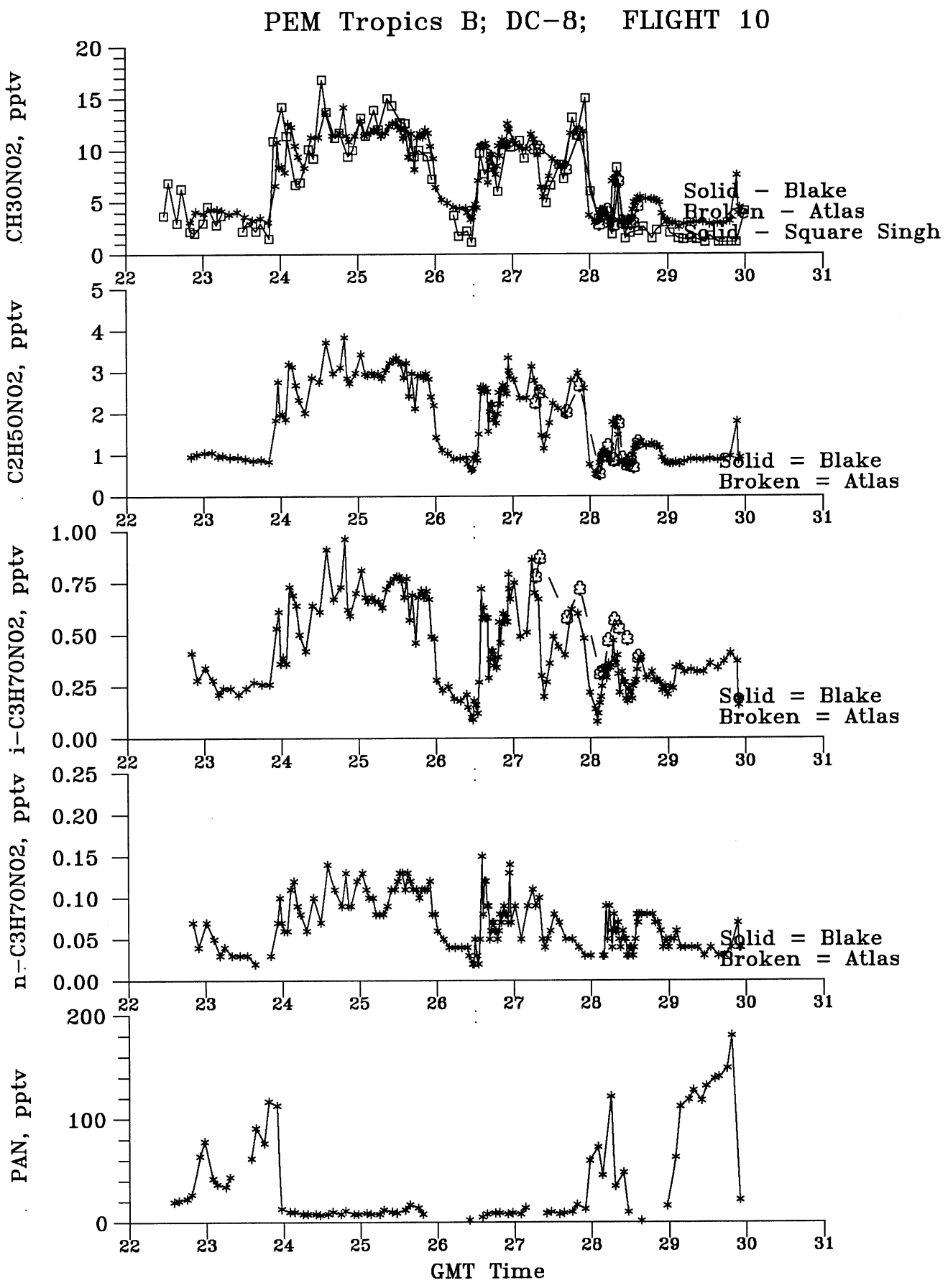

PEM Tropics B; DC-8; FLIGHT 10
C3H8/C2H6
NO DATA
C2H4/C2H6
C2H2/CO, ppt/ppb
C2H4/CO, ppt/ppb
C2H6/CO, ppt/ppb
GMT Time

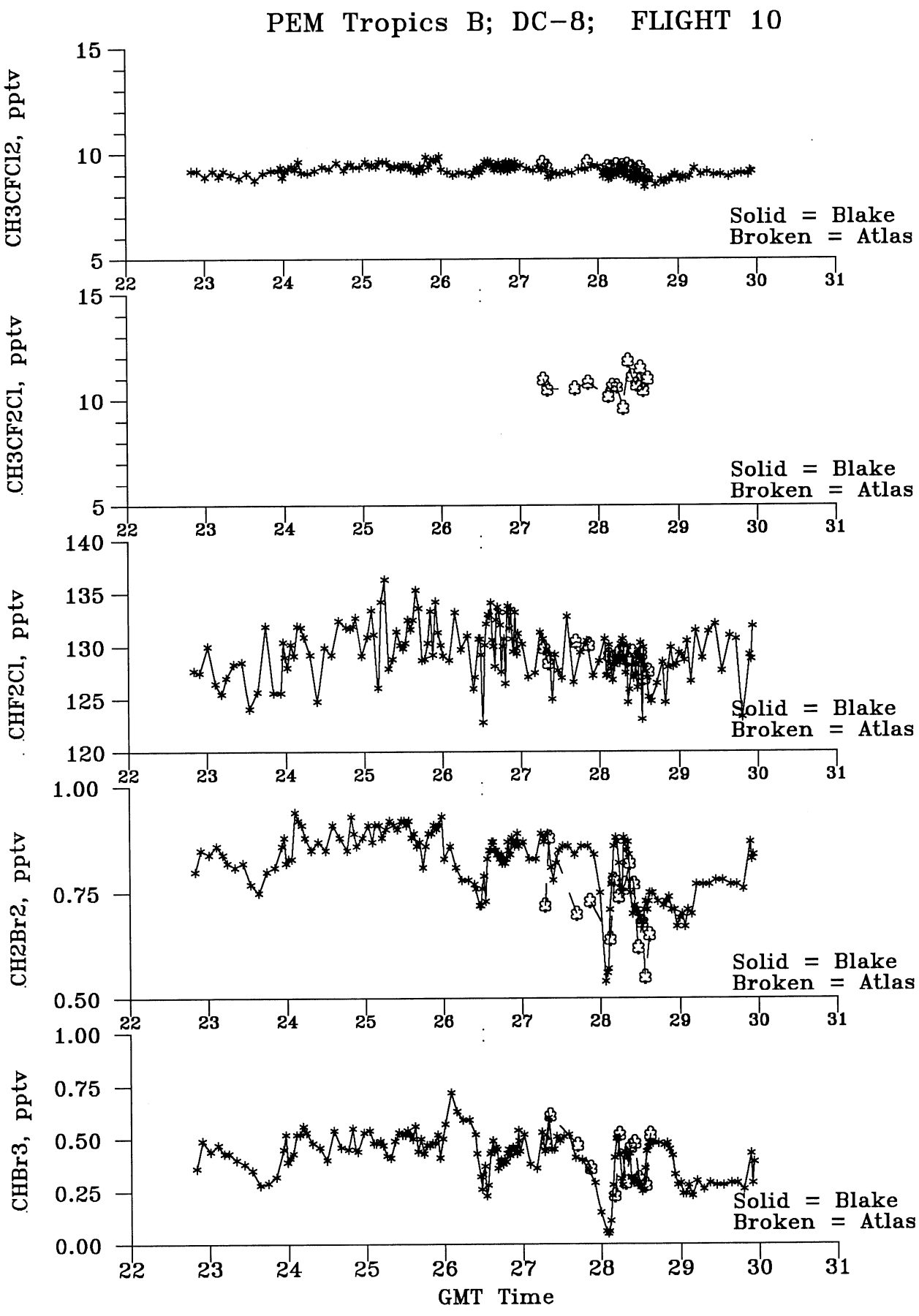

PEM Tropics B; DC-8; FLIGHT 10
CCl4, pptv
105
100
95
C2Cl4, pptv
4
3
2
1
0
Solid = Blake
Broken = Atlas
Solid (Square) = Singh
CH3CCl3, pptv
65
60
55
CH3I, pptv
1.0
0.5
0.0
CH3Cl, pptv
600
550
500
22
23
24
25
26
27
28
29
30
31
GMT Time

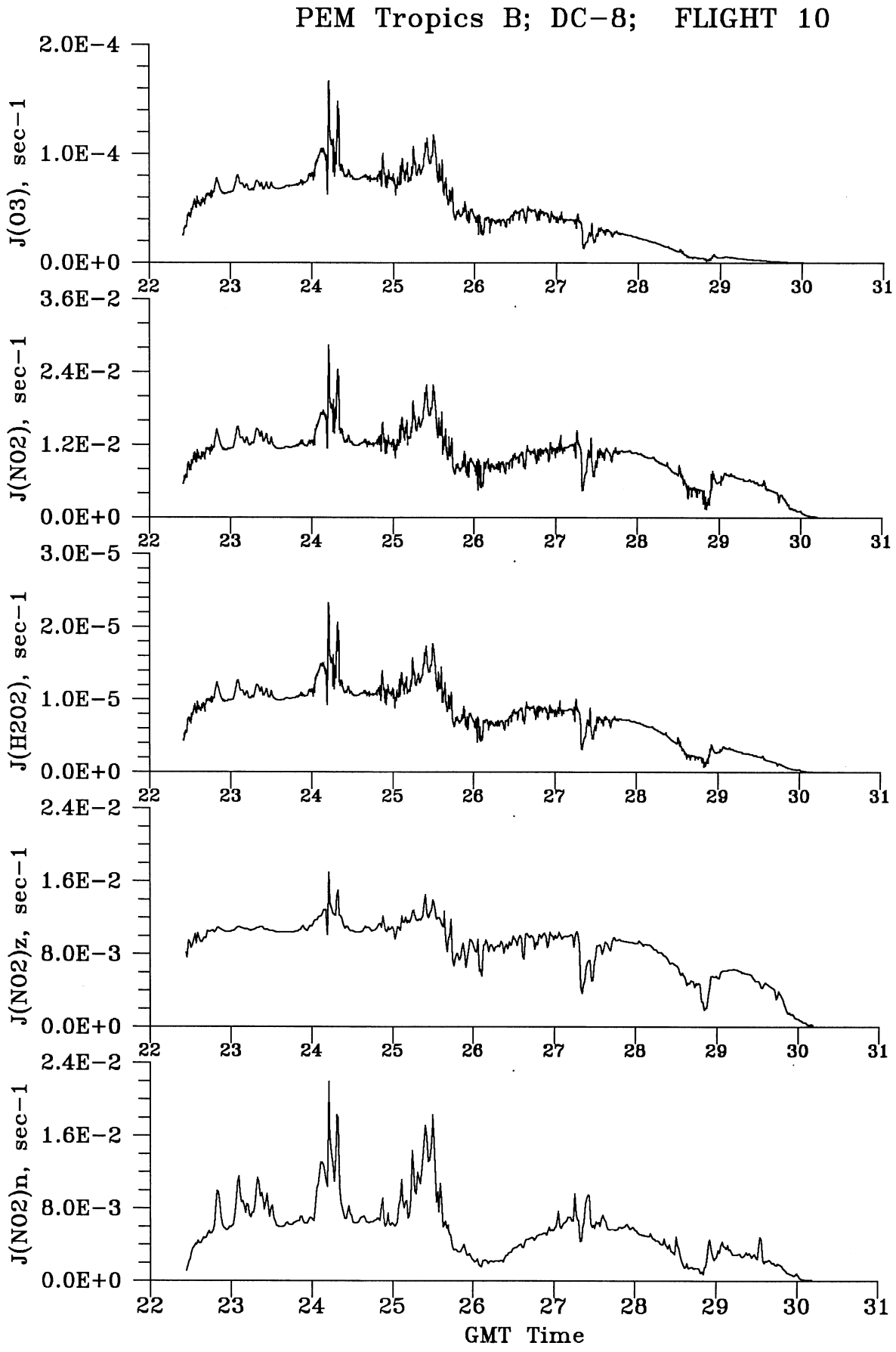

PEM Tropics B; DC-8; FLIGHT 10
CHCl3, pptv
Solid = Blake
Broken = Atlas
CA+, pptv
ULTRA, no./cm3
FINE-UNht,no./cm3
FINE RATIO (Ht/UHt)
GMT Time

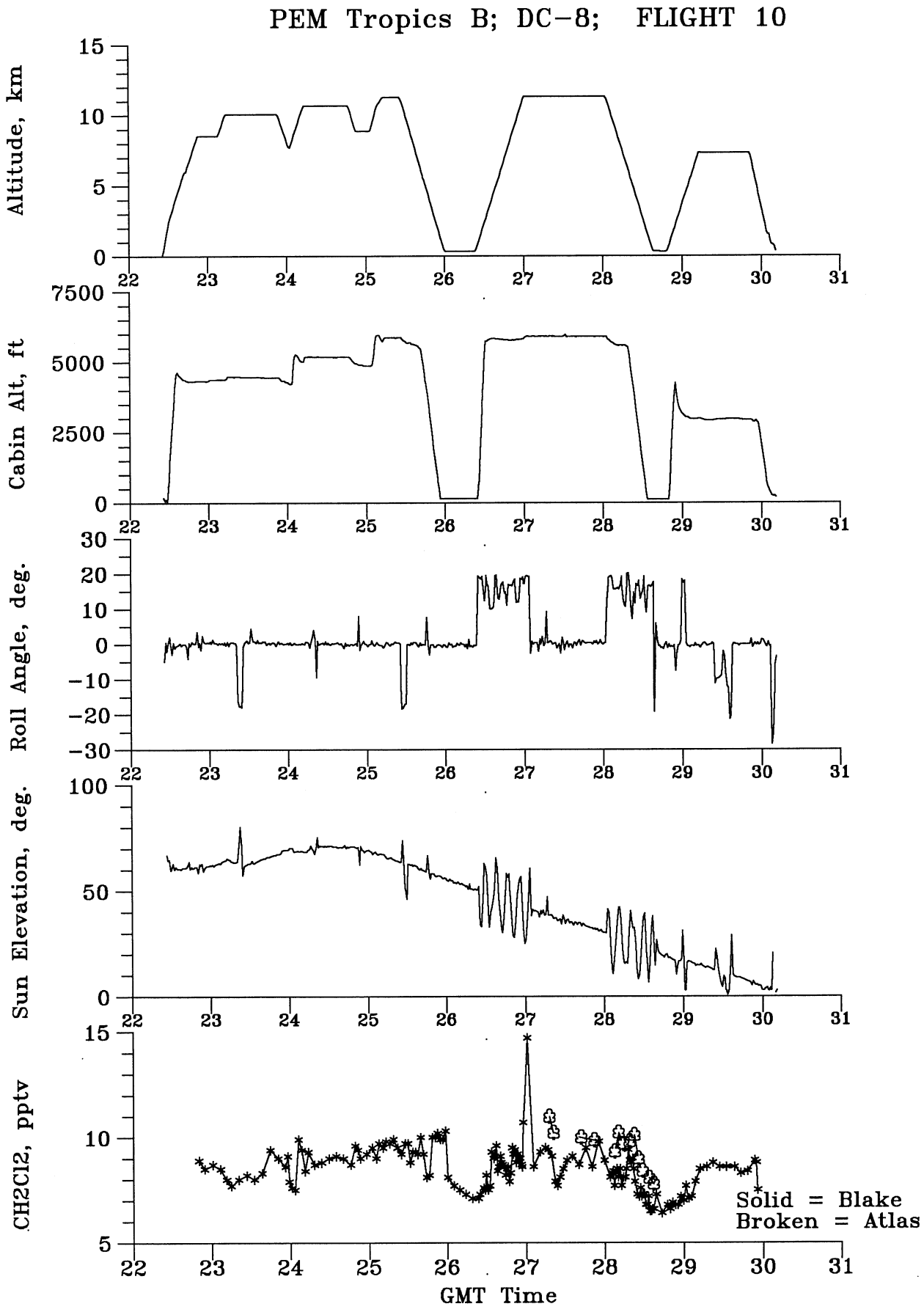

PEM Tropics B; DC-8; FLIGHT 10
H2O2, pptv
2000
1000
0
CH3OOH & CH3COCH3, pptv
1000
500
0
Solid - CH3OOH
Broken - CH3COCH3
HO2, pptv
20
15
10
5
0
BE7, fci/scm
1500
1000
500
0
CH2O, pptv
750
500
250
0
22
23
24
25
26
27
28
29
30
31
GMT Time


PEM Tropics B; DC-8; FLIGHT 10
NO3-, pptv
75
50
25
0
Cl-, pptv
5000
2500
0
CH3SO3-, pptv
18
12
6
0
SO4-, pptv
100
50
0
NH4+, pptv
150
100
50
0
22
23
24
25
26
27
28
29
30
31
GMT Time

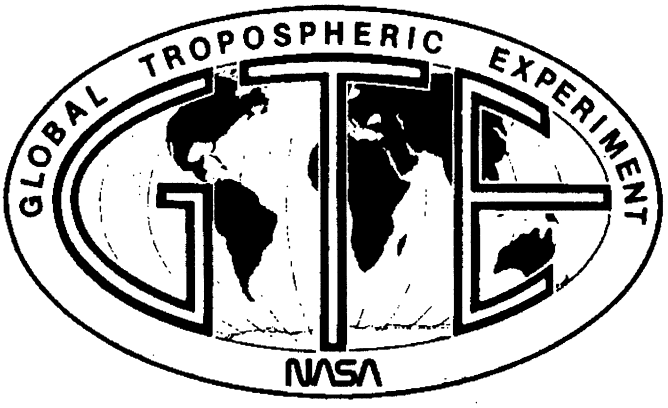

PEM Tropics B; DC-8; FLIGHT 10
CH3ONO2, pptv
Solid - Blake
Broken - Atlas
Solid - Square Singh
C2H5ONO2, pptv
Solid = Blake
Broken = Atlas
i-C3H7ONO2, pptv
Solid = Blake
Broken = Atlas
n-C3H7ONO2, pptv
Solid = Blake
Broken = Atlas
PAN, pptv
GMT Time


PEM Tropics B; DC-8; FLIGHT 10
CH3CFCl2, pptv
15
10
5
Solid = Blake
Broken = Atlas
CH3CF2Cl, pptv
15
10
5
Solid = Blake
Broken = Atlas
CHF2Cl, pptv
140
135
130
125
120
Solid = Blake
Broken = Atlas
CH2Br2, pptv
1.00
0.75
0.50
Solid = Blake
Broken = Atlas
CHBr3, pptv
1.00
0.75
0.50
0.25
0.00
Solid = Blake
Broken = Atlas
22
23
24
25
26
27
28
29
30
31
GMT Time


PEM Tropics B; DC-8; FLIGHT 10
J(O3), sec-1
2.0E-4
1.0E-4
0.0E+0
J(NO2), sec-1
3.6E-2
2.4E-2
1.2E-2
0.0E+0
J(H2O2), sec-1
3.0E-5
2.0E-5
1.0E-5
0.0E+0
J(NO2)z, sec-1
2.4E-2
1.6E-2
8.0E-3
0.0E+0
J(NO2)n, sec-1
2.4E-2
1.6E-2
8.0E-3
0.0E+0
22
23
24
25
26
27
28
29
30
31
GMT Time


PEM Tropics B; DC-8; FLIGHT 10
Altitude, km
15
10
5
0
Cabin Alt, ft
7500
5000
2500
0
Roll Angle, deg.
30
20
10
0
-10
-20
-30
Sun Elevation, deg.
100
50
0
CH2Cl2, pptv
15
10
5
22
23
24
25
26
27
28
29
30
31
GMT Time
Solid = Blake
Broken = Atlas

PLOTS OF FINAL CHEMICAL DATA



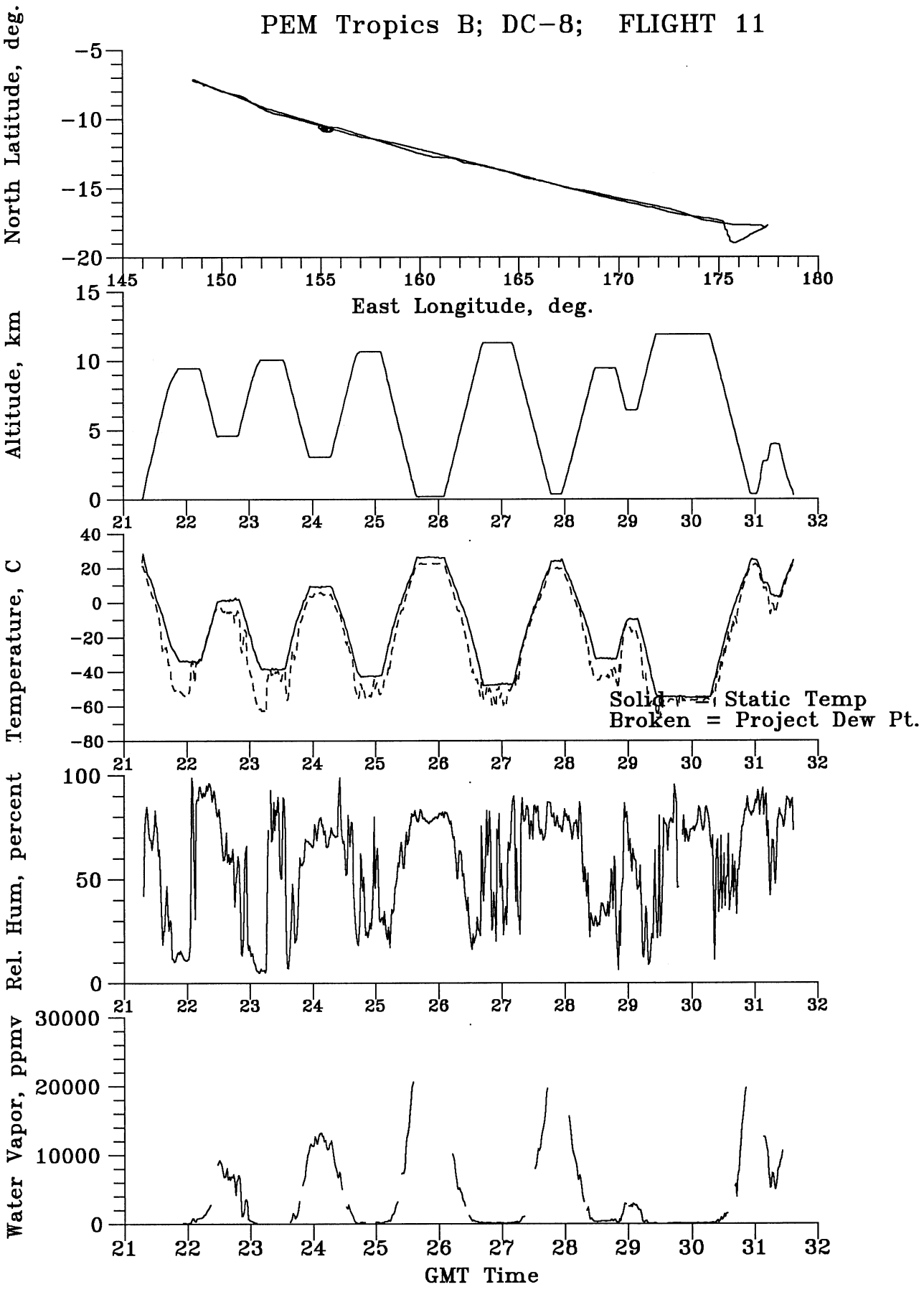
PEM-TROPICS B

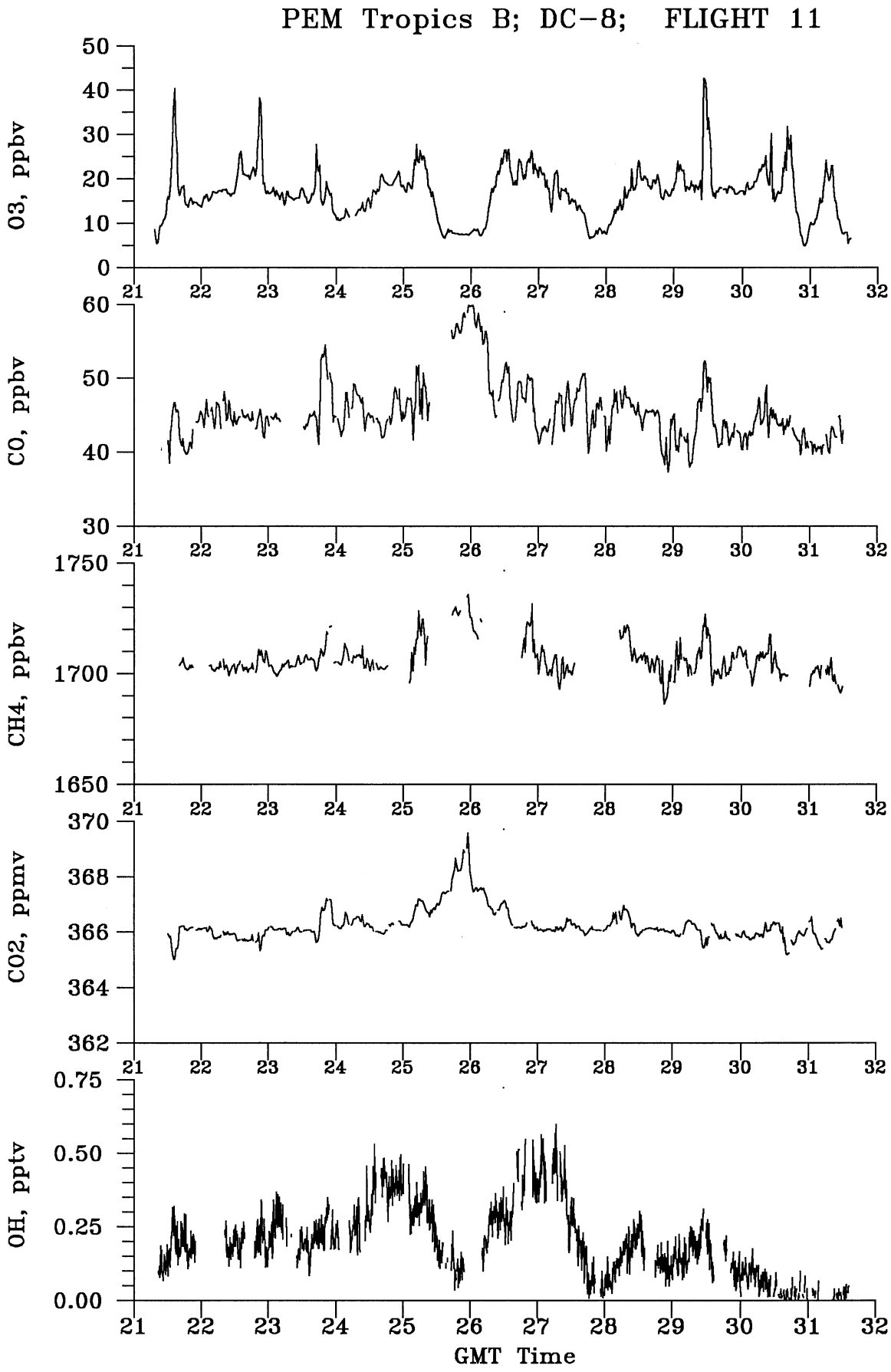
Flight 11D

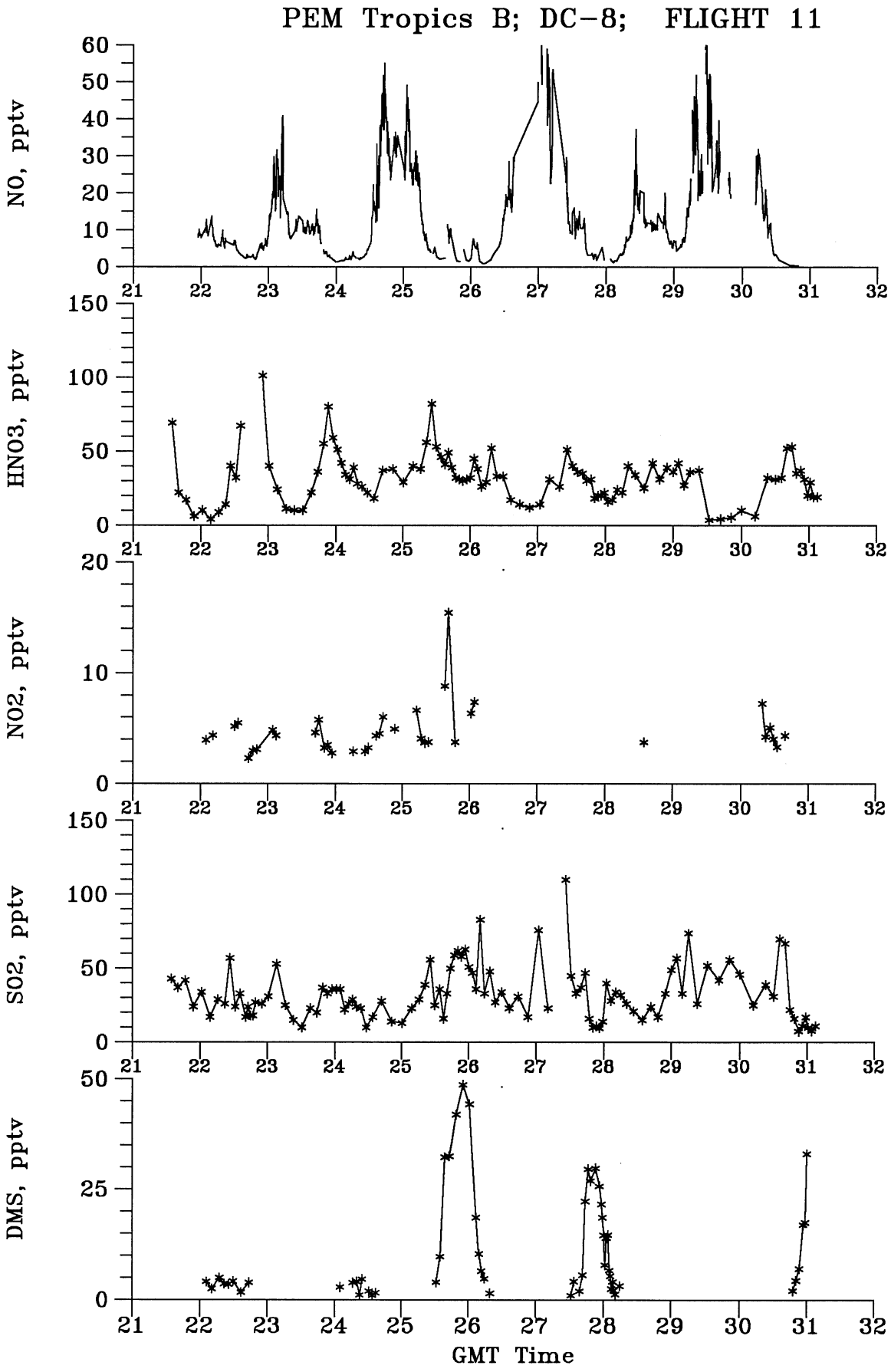
Local: Fiji No. 2

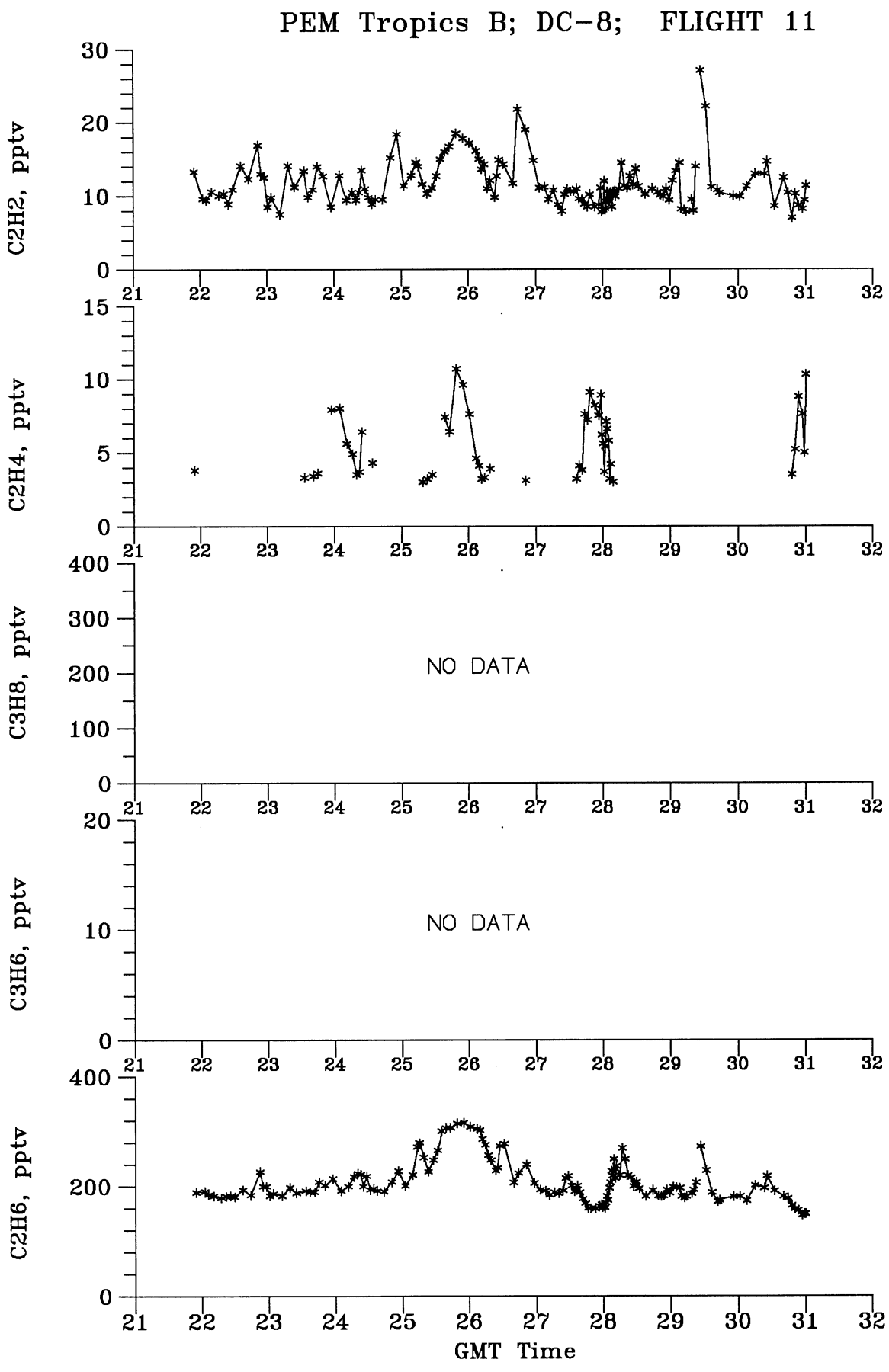
Ozone Trough

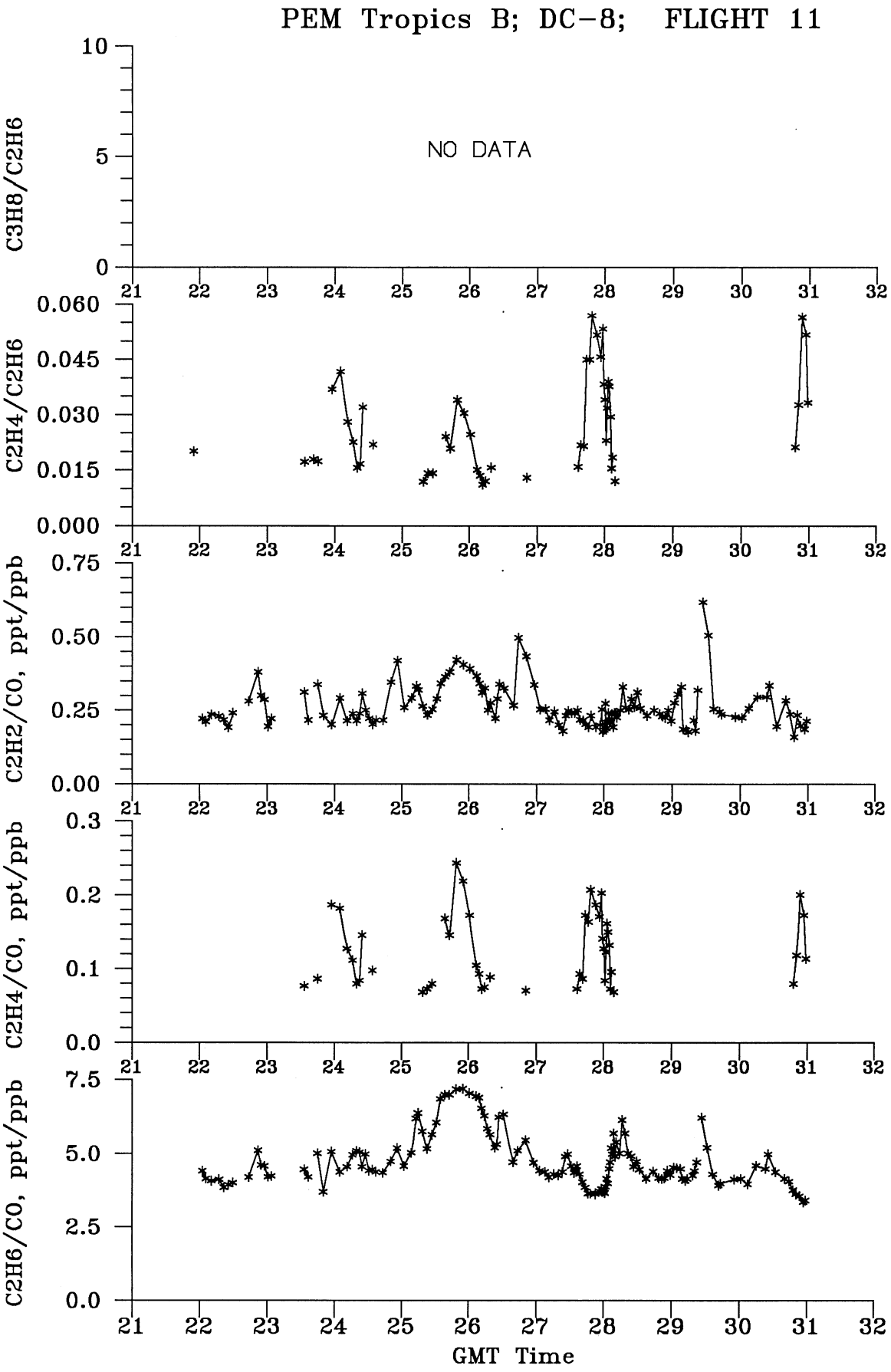
March 22, 1999

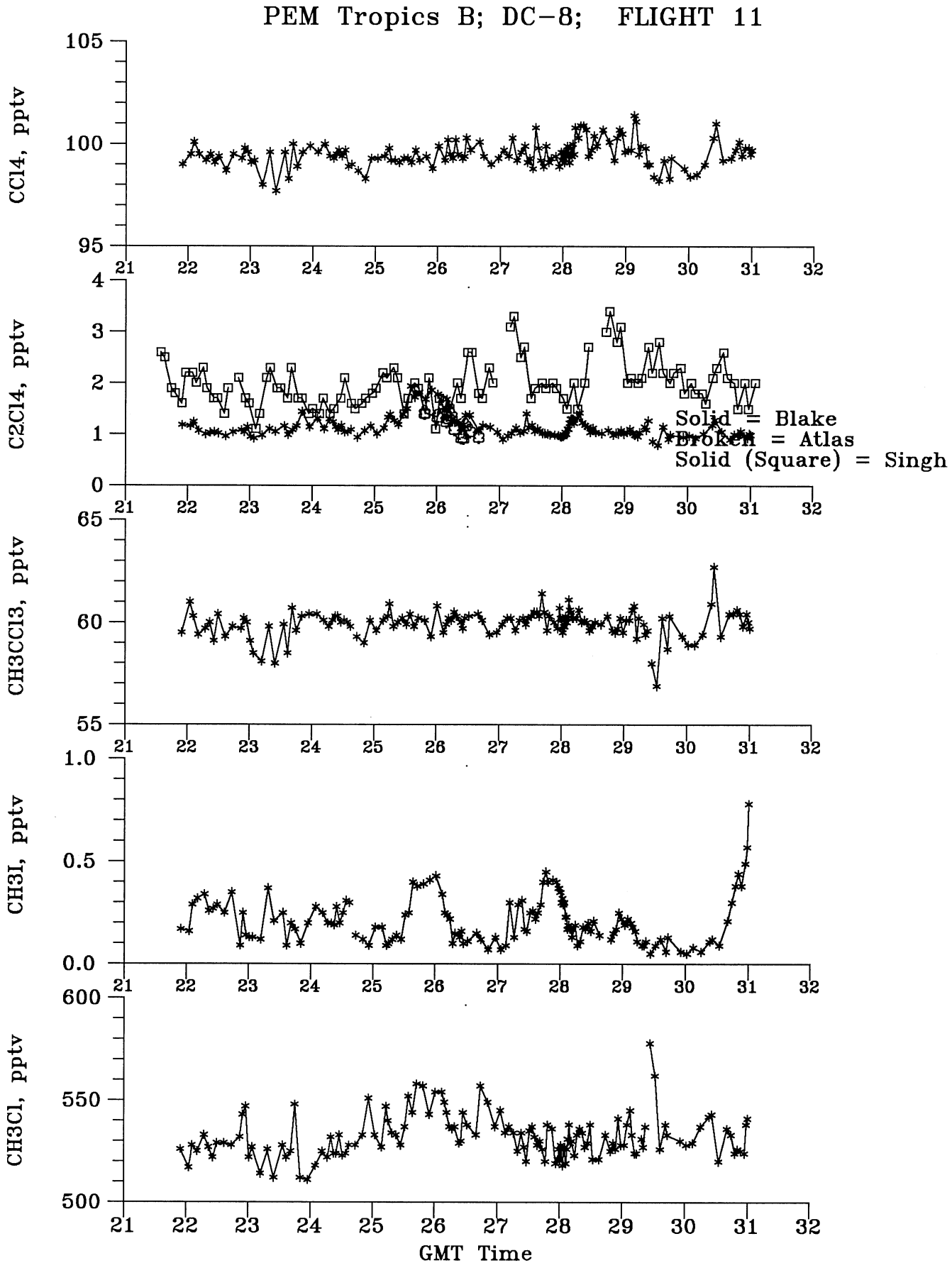

PEM Tropics B; DC-8; FLIGHT 11
North Latitude, deg.
-5
-10
-15
-20
145
150
155
160
165
170
175
180
East Longitude, deg.
Altitude, km
15
10
5
0
21
22
23
24
25
26
27
28
29
30
31
32
Temperature, C
40
20
0
-20
-40
-60
-80
Solid = Static Temp
Broken = Project Dew Pt.
Rel. Hum, percent
100
50
0
Water Vapor, ppmv
30000
20000
10000
0
GMT Time

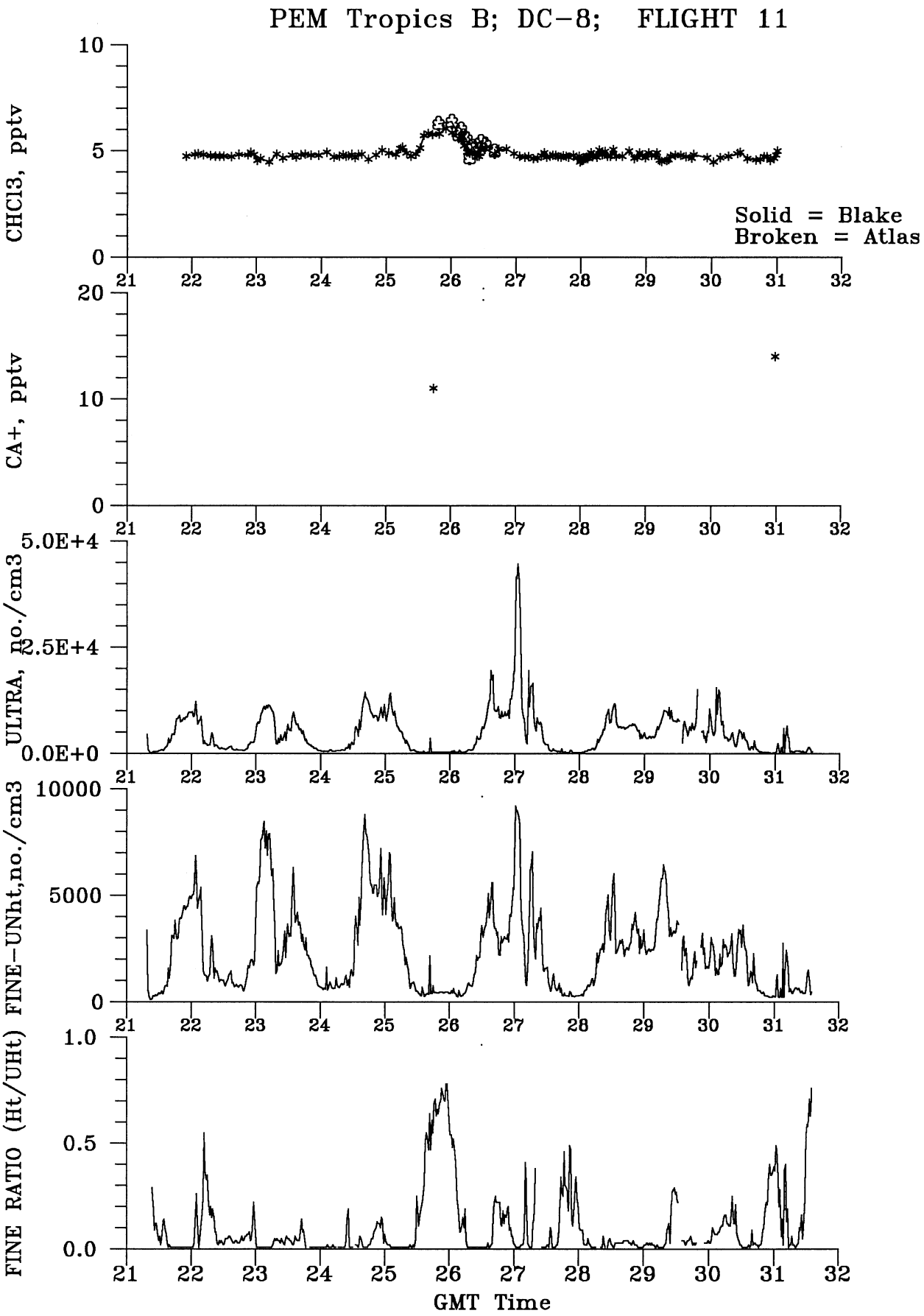

PEM Tropics B; DC-8; FLIGHT 11
O3, ppbv
50
40
30
20
10
0
CO, ppbv
60
50
40
30
CH4, ppbv
1750
1700
1650
CO2, ppmv
370
368
366
364
362
OH, pptv
0.75
0.50
0.25
0.00
21
22
23
24
25
26
27
28
29
30
31
32
GMT Time

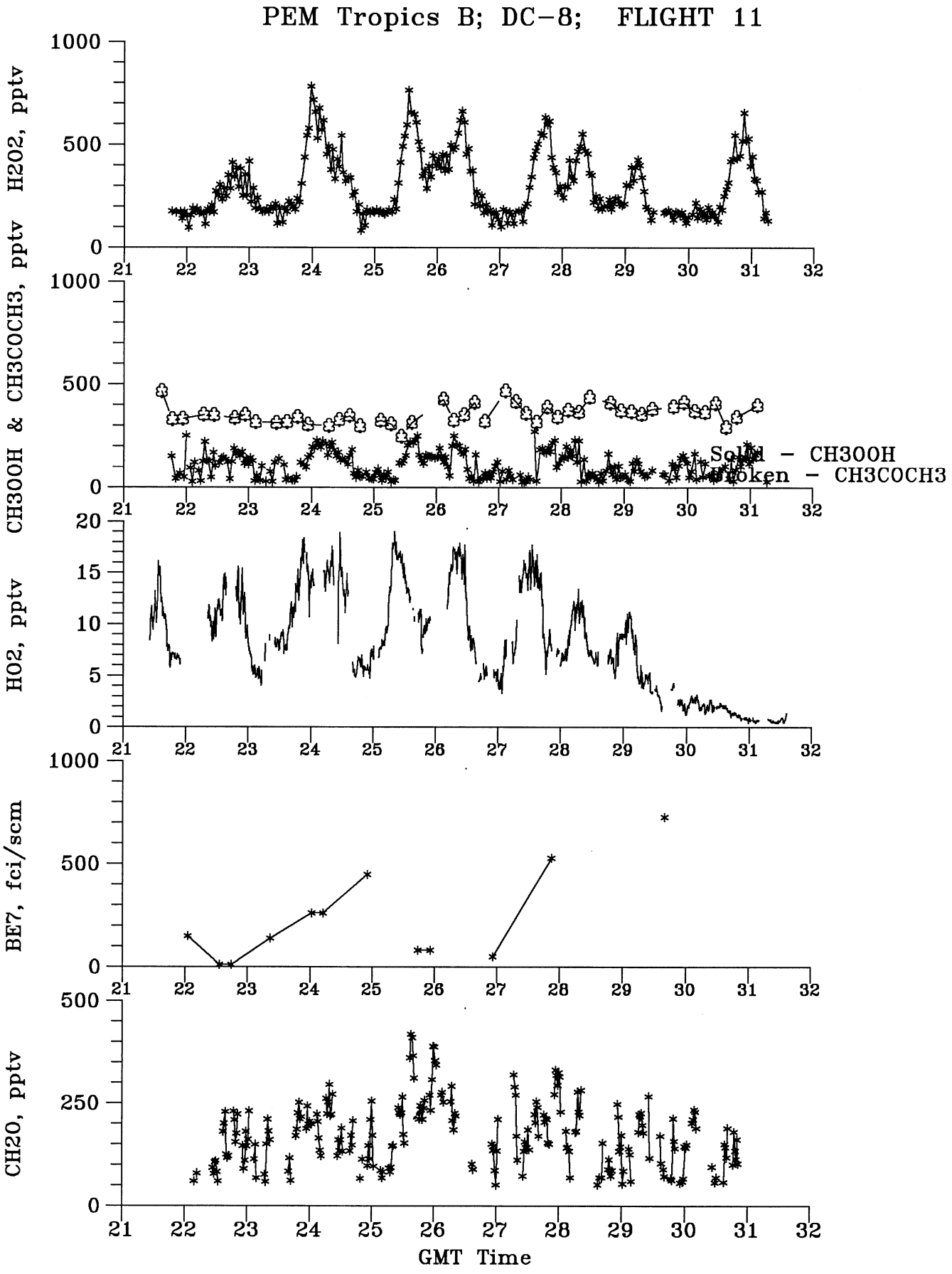

PEM Tropics B; DC-8; FLIGHT 11
NO, pptv
HNO3, pptv
NO2, pptv
SO2, pptv
DMS, pptv
GMT Time

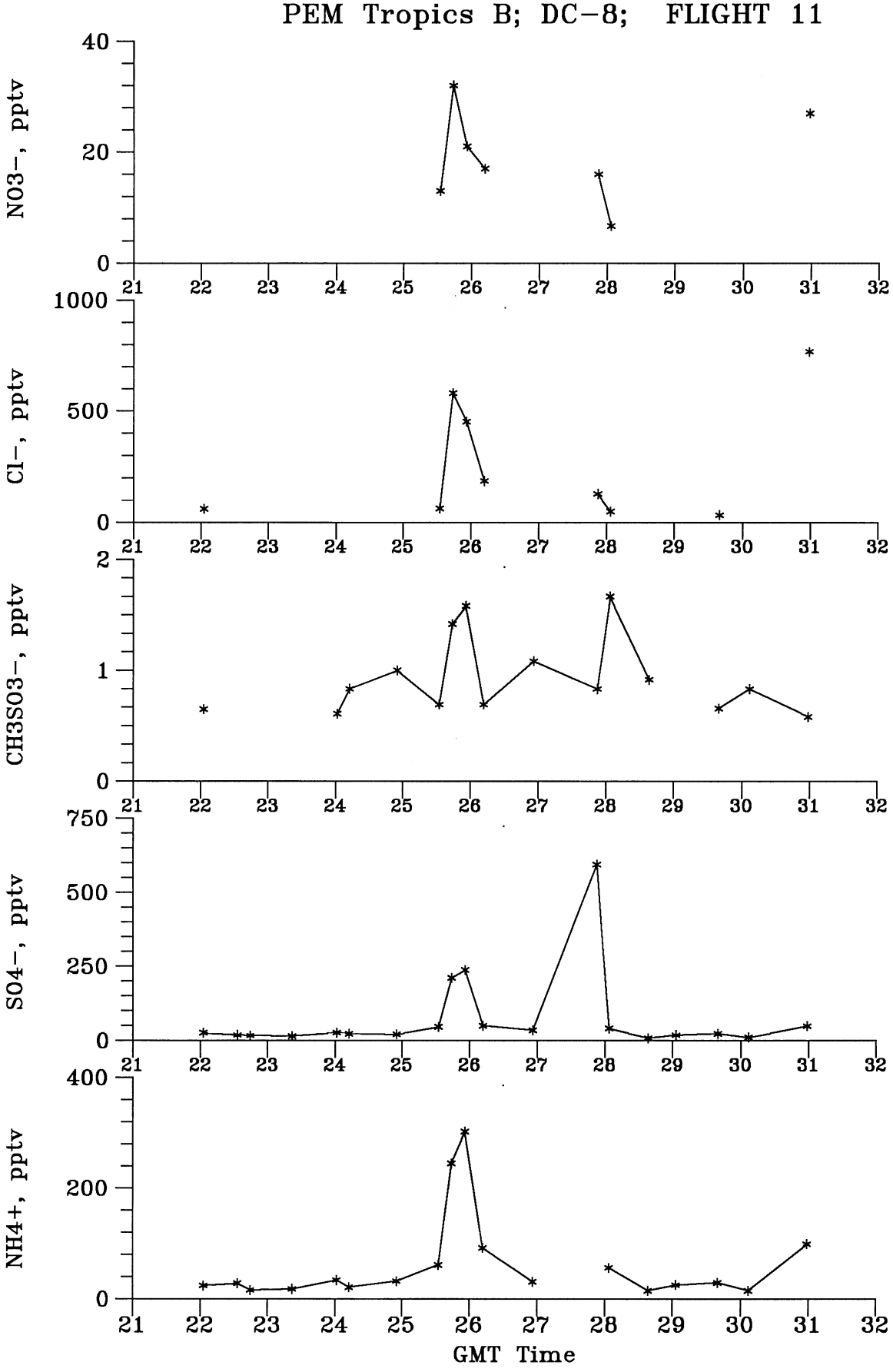

PEM Tropics B; DC-8; FLIGHT 11
C2H2, pptv
C2H4, pptv
C3H8, pptv
NO DATA
C3H6, pptv
NO DATA
C2H6, pptv
GMT Time

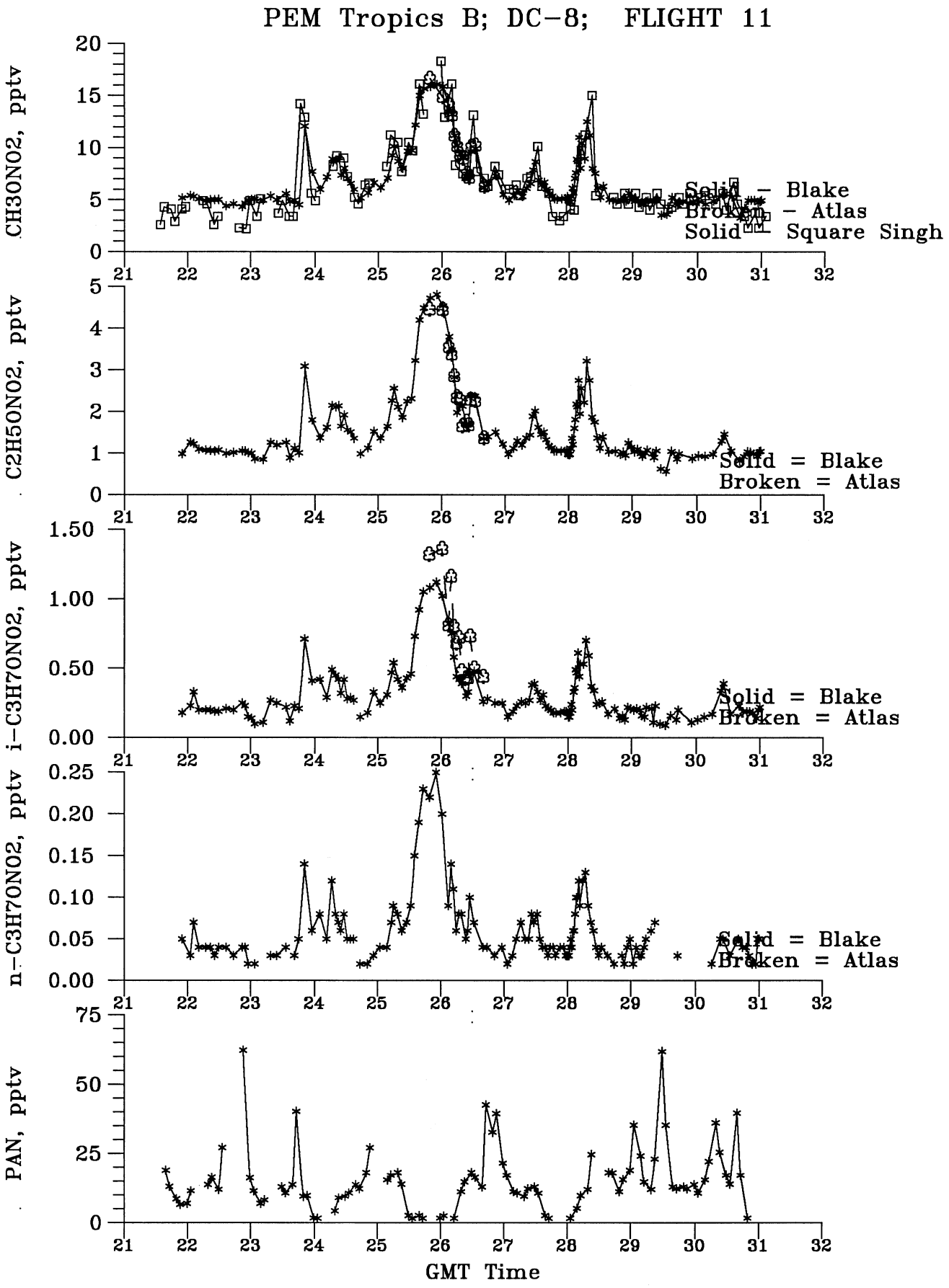

PEM Tropics B; DC-8; FLIGHT 11
C3H8/C2H6
NO DATA
C2H4/C2H6
C2H2/CO, ppt/ppb
C2H4/CO, ppt/ppb
C2H6/CO, ppt/ppb
GMT Time

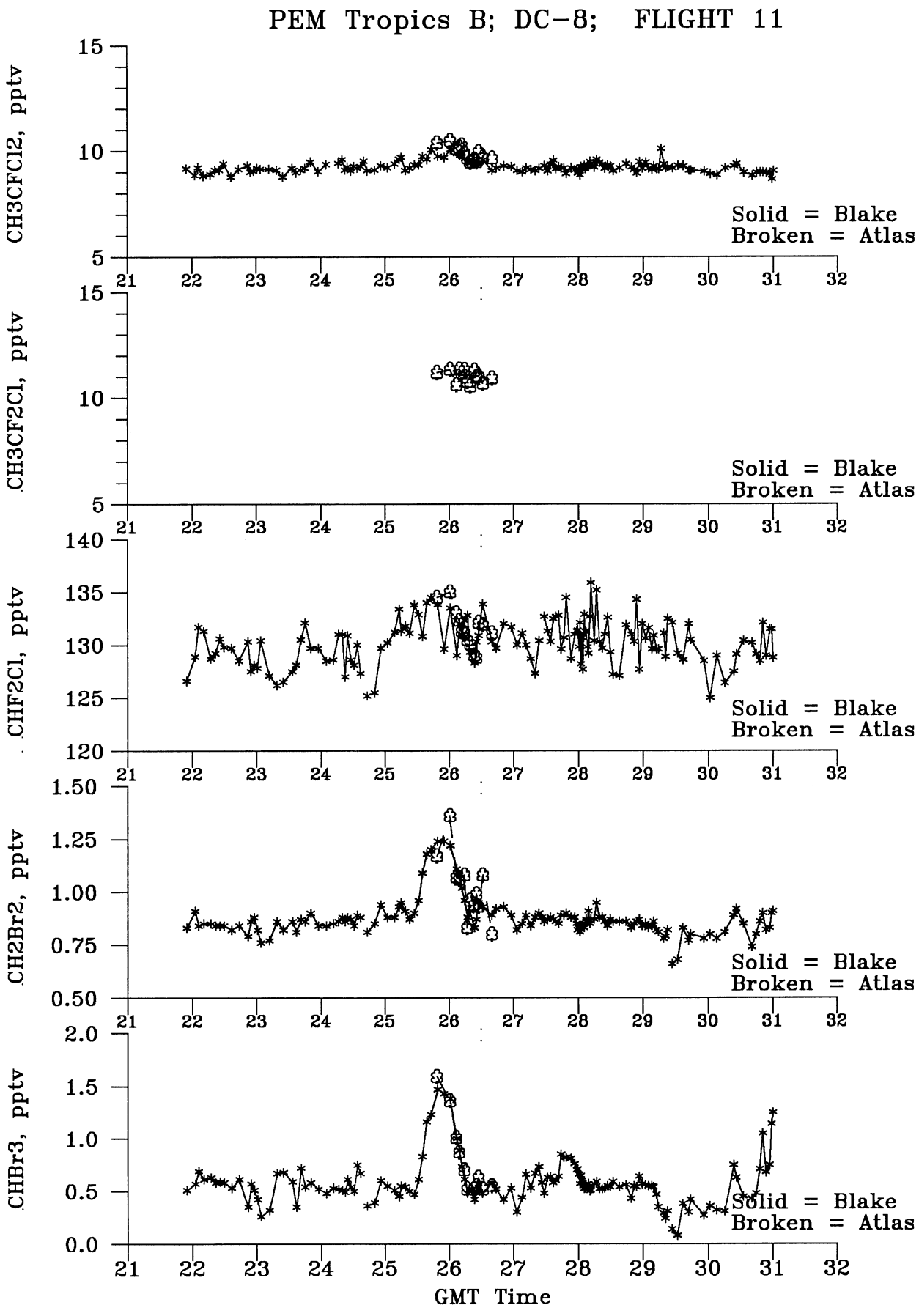

PEM Tropics B; DC-8; FLIGHT 11
CCl4, pptv
105
100
95
C2Cl4, pptv
4
3
2
1
0
Solid = Blake
Broken = Atlas
Solid (Square) = Singh
CH3CCl3, pptv
65
60
55
CH3I, pptv
1.0
0.5
0.0
CH3Cl, pptv
600
550
500
21
22
23
24
25
26
27
28
29
30
31
32
GMT Time

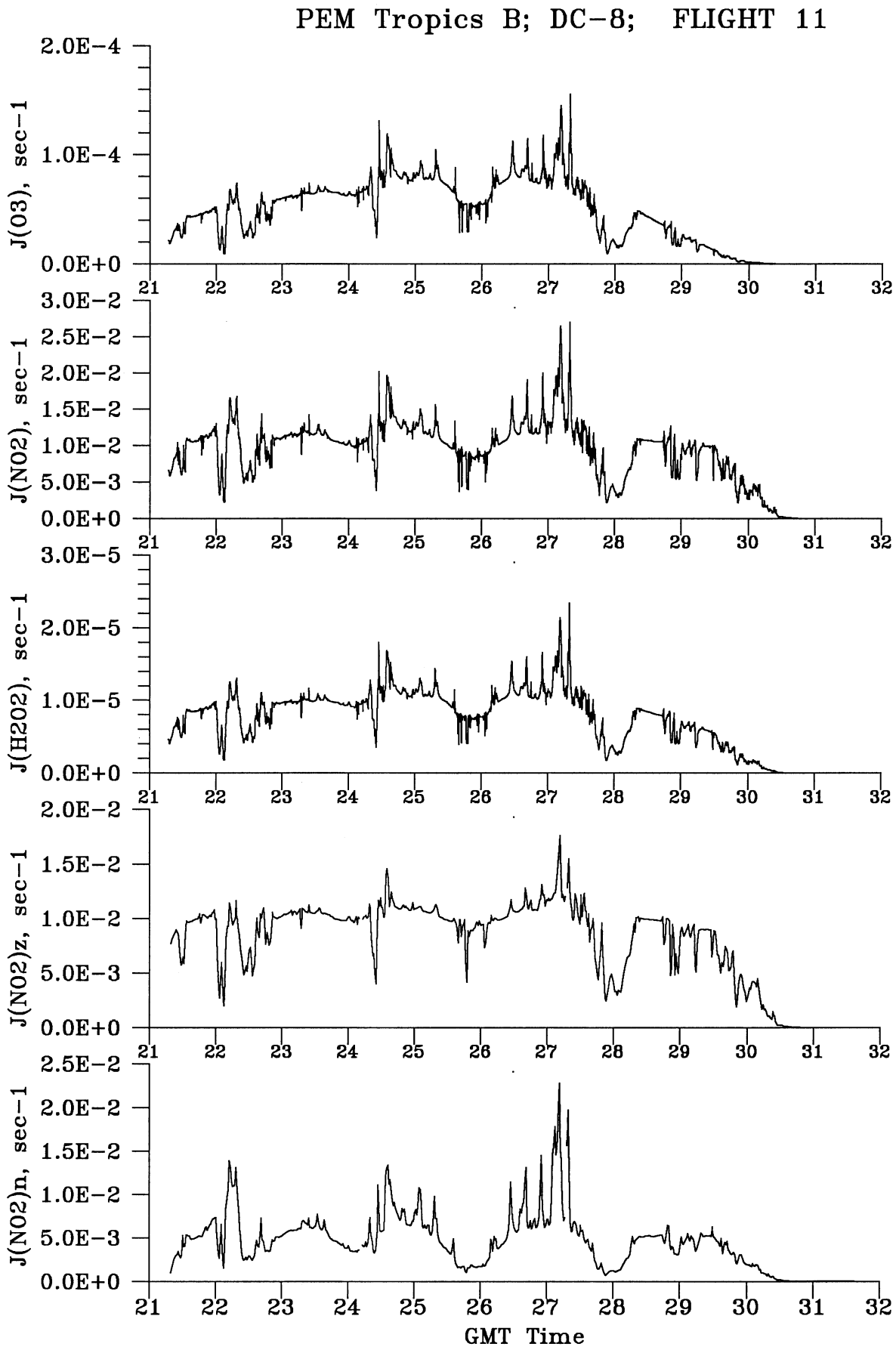

PEM Tropics B; DC-8; FLIGHT 11
CHCl3, pptv
Solid = Blake
Broken = Atlas
CA+, pptv
ULTRA, no./cm3
FINE-UNht,no./cm3
FINE RATIO (Ht/UHt)
GMT Time

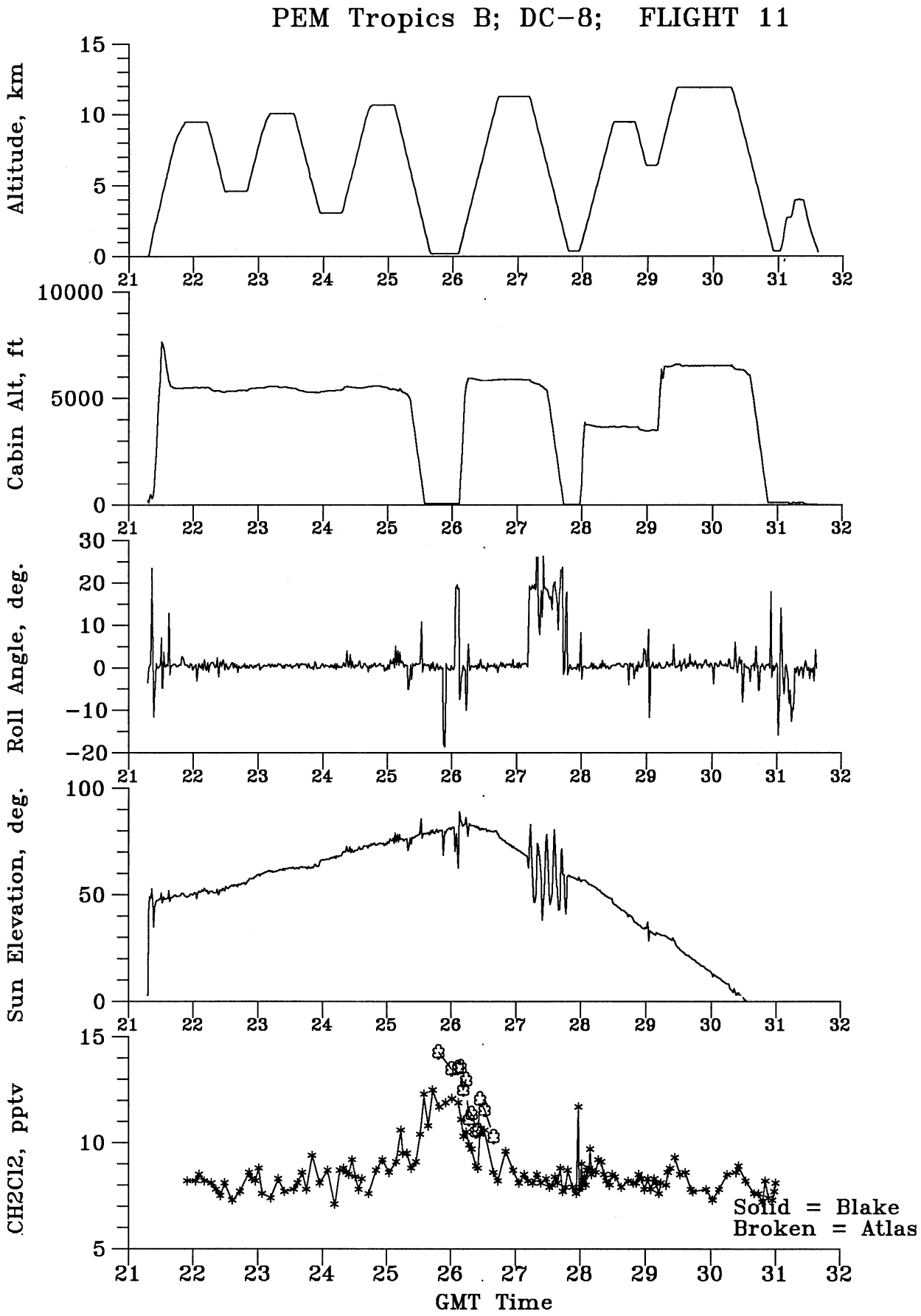

PEM Tropics B; DC-8; FLIGHT 11
H2O2, pptv
CH3OOH & CH3COCH3, pptv
Solid - CH3OOH
Broken - CH3COCH3
HO2, pptv
BE7, fci/scm
CH2O, pptv
GMT Time


PEM Tropics B; DC-8; FLIGHT 11
NO3-, pptv
Cl-, pptv
CH3SO3-, pptv
SO4-, pptv
NH4+, pptv
GMT Time
21
22
23
24
25
26
27
28
29
30
31
32

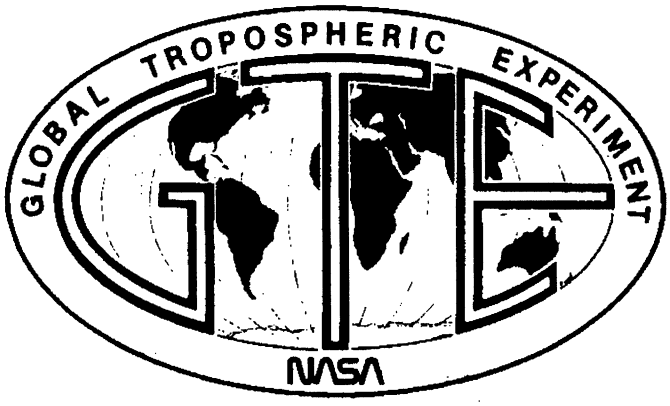

PEM Tropics B; DC-8; FLIGHT 11
CH3ONO2, pptv
Solid = Blake
Broken = Atlas
Solid = Square Singh
C2H5ONO2, pptv
Solid = Blake
Broken = Atlas
i-C3H7ONO2, pptv
Solid = Blake
Broken = Atlas
n-C3H7ONO2, pptv
Solid = Blake
Broken = Atlas
PAN, pptv
GMT Time


PEM Tropics B; DC-8; FLIGHT 11
CH3CFCl2, pptv
15
10
5
Solid = Blake
Broken = Atlas
CH3CF2Cl, pptv
15
10
5
Solid = Blake
Broken = Atlas
CHF2Cl, pptv
140
135
130
125
120
Solid = Blake
Broken = Atlas
CH2Br2, pptv
1.50
1.25
1.00
0.75
0.50
Solid = Blake
Broken = Atlas
CHBr3, pptv
2.0
1.5
1.0
0.5
0.0
Solid = Blake
Broken = Atlas
21 22 23 24 25 26 27 28 29 30 31 32
GMT Time


PEM Tropics B; DC-8; FLIGHT 11
J(O3), sec-1
2.0E-4
1.0E-4
0.0E+0
J(NO2), sec-1
3.0E-2
2.5E-2
2.0E-2
1.5E-2
1.0E-2
5.0E-3
0.0E+0
J(H2O2), sec-1
3.0E-5
2.0E-5
1.0E-5
0.0E+0
J(NO2)z, sec-1
2.0E-2
1.5E-2
1.0E-2
5.0E-3
0.0E+0
J(NO2)n, sec-1
2.5E-2
2.0E-2
1.5E-2
1.0E-2
5.0E-3
0.0E+0
21 22 23 24 25 26 27 28 29 30 31 32
GMT Time


PEM Tropics B; DC-8; FLIGHT 11
Altitude, km
Cabin Alt, ft
Roll Angle, deg.
Sun Elevation, deg.
CH2Cl2, pptv
Solid = Blake
Broken = Atlas
GMT Time

PLOTS OF FINAL CHEMICAL DATA



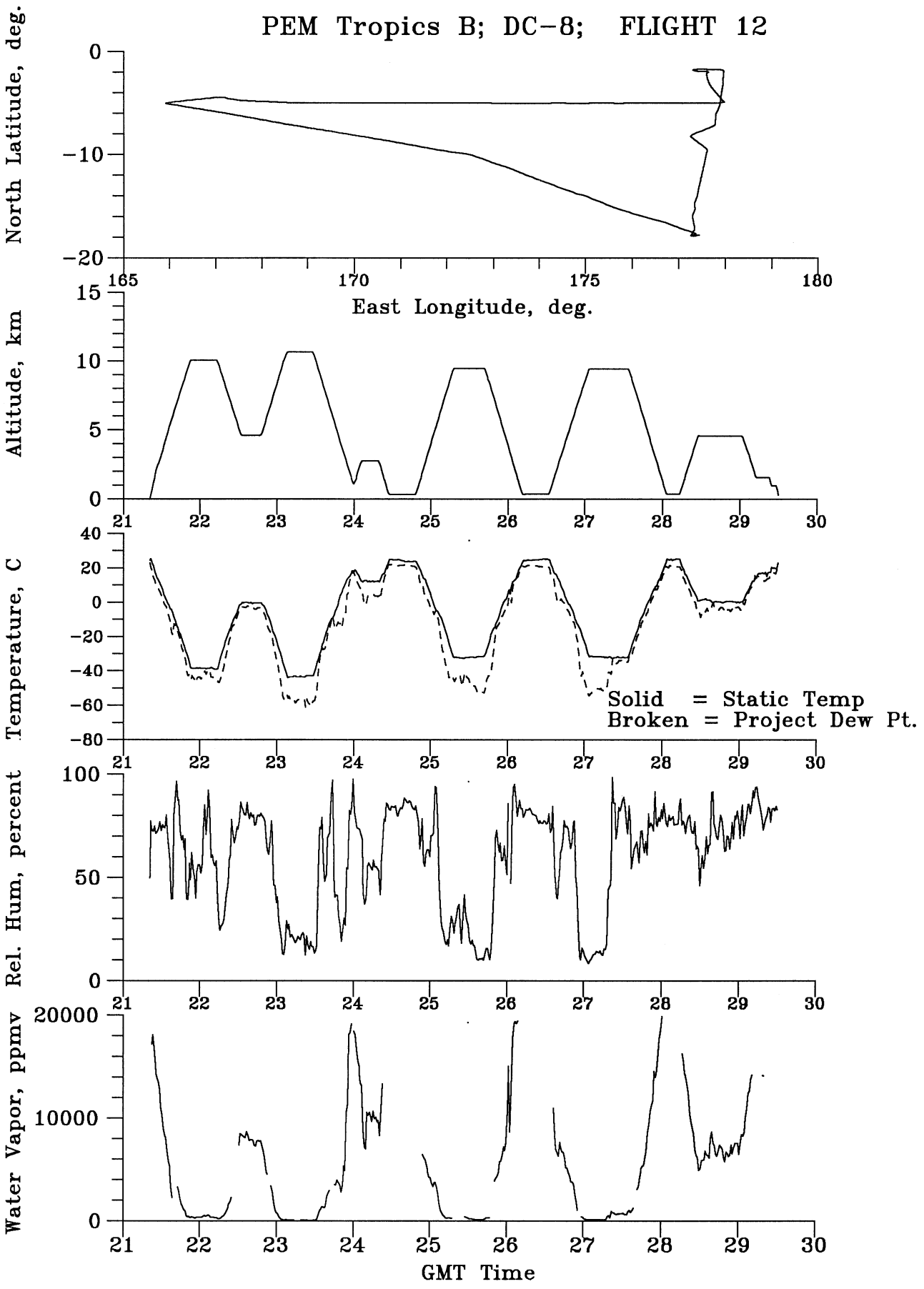
PEM-TROPICS B

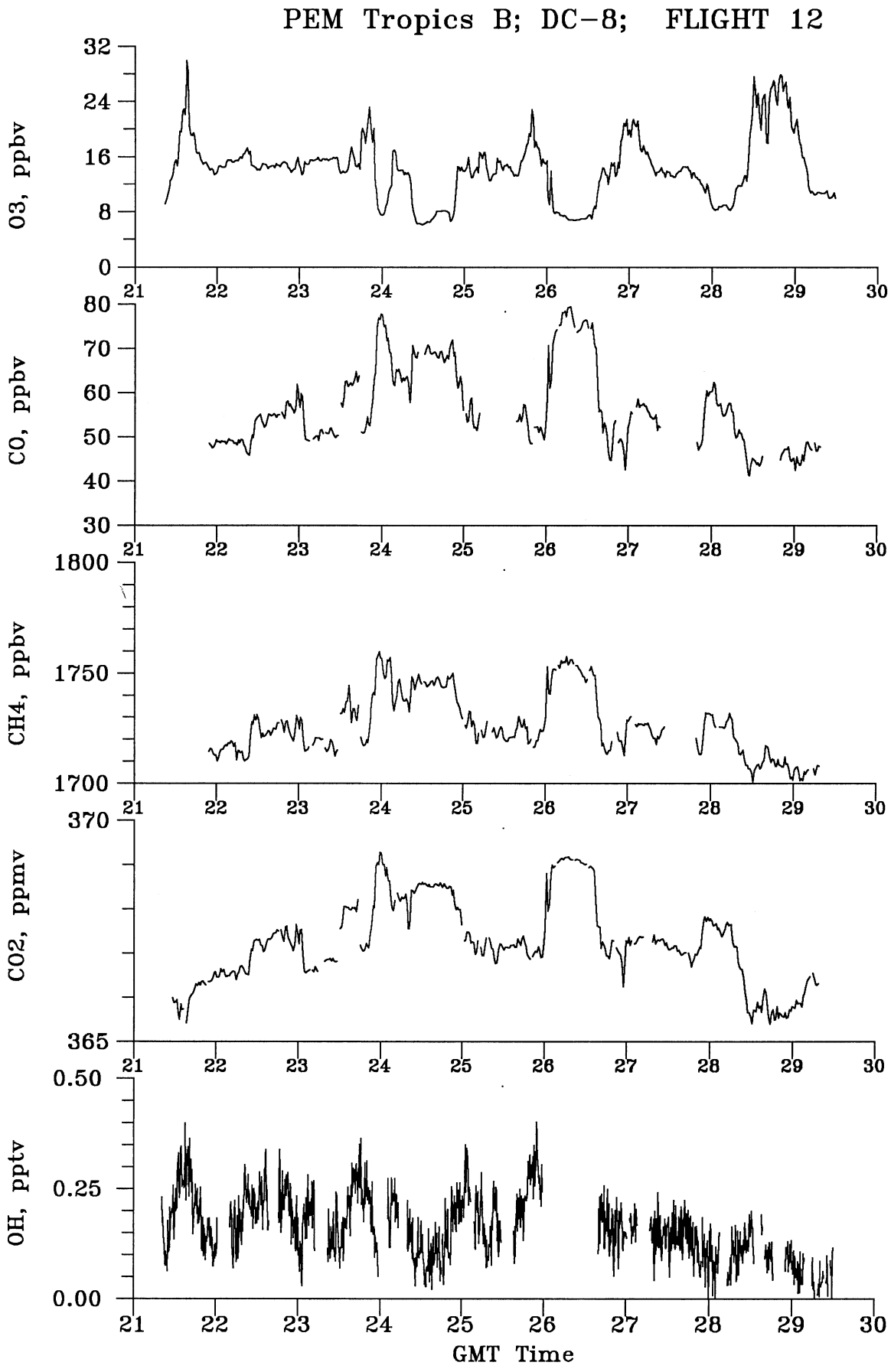
Flight 12D

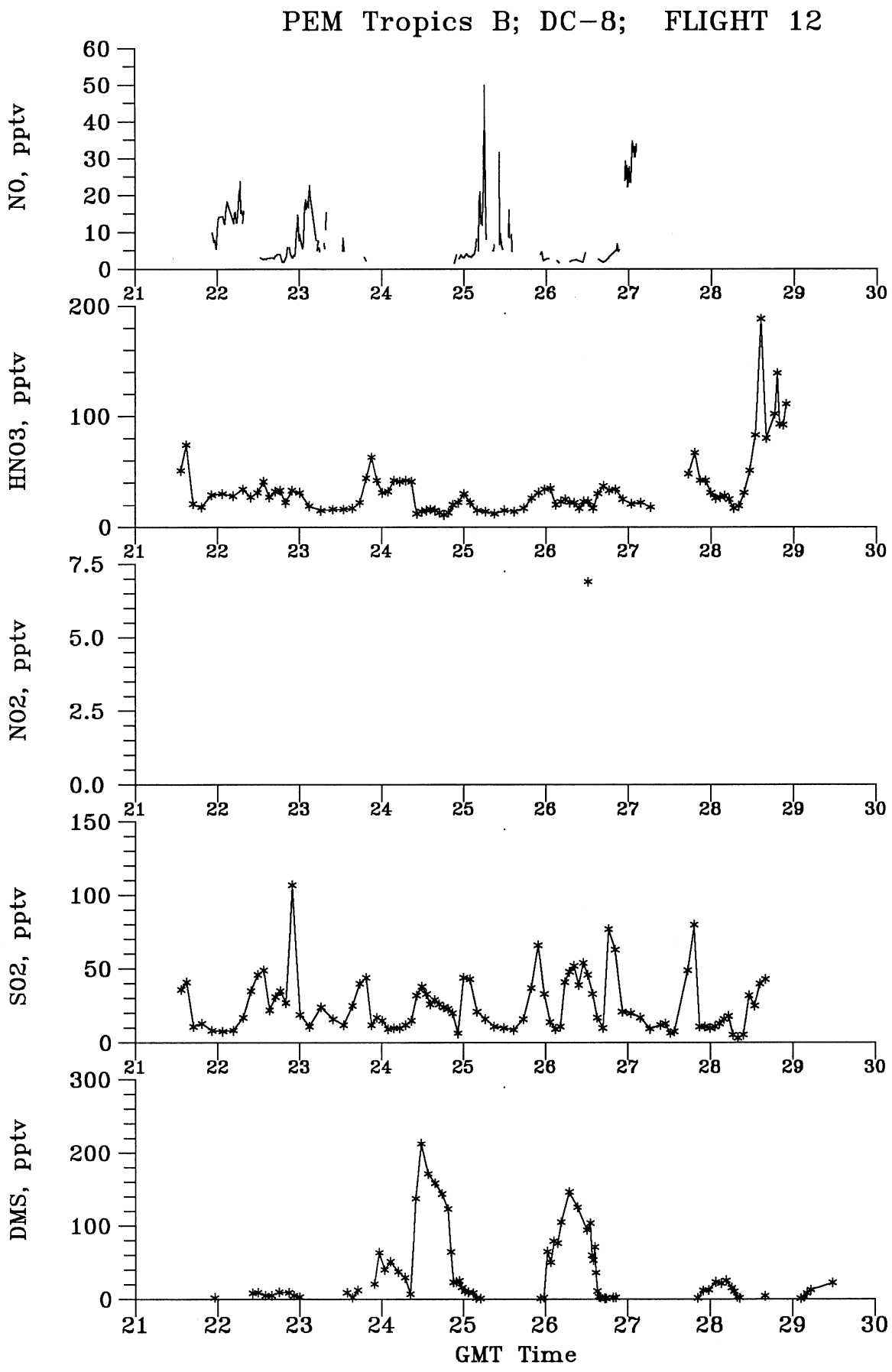
Local: Fiji No. 3

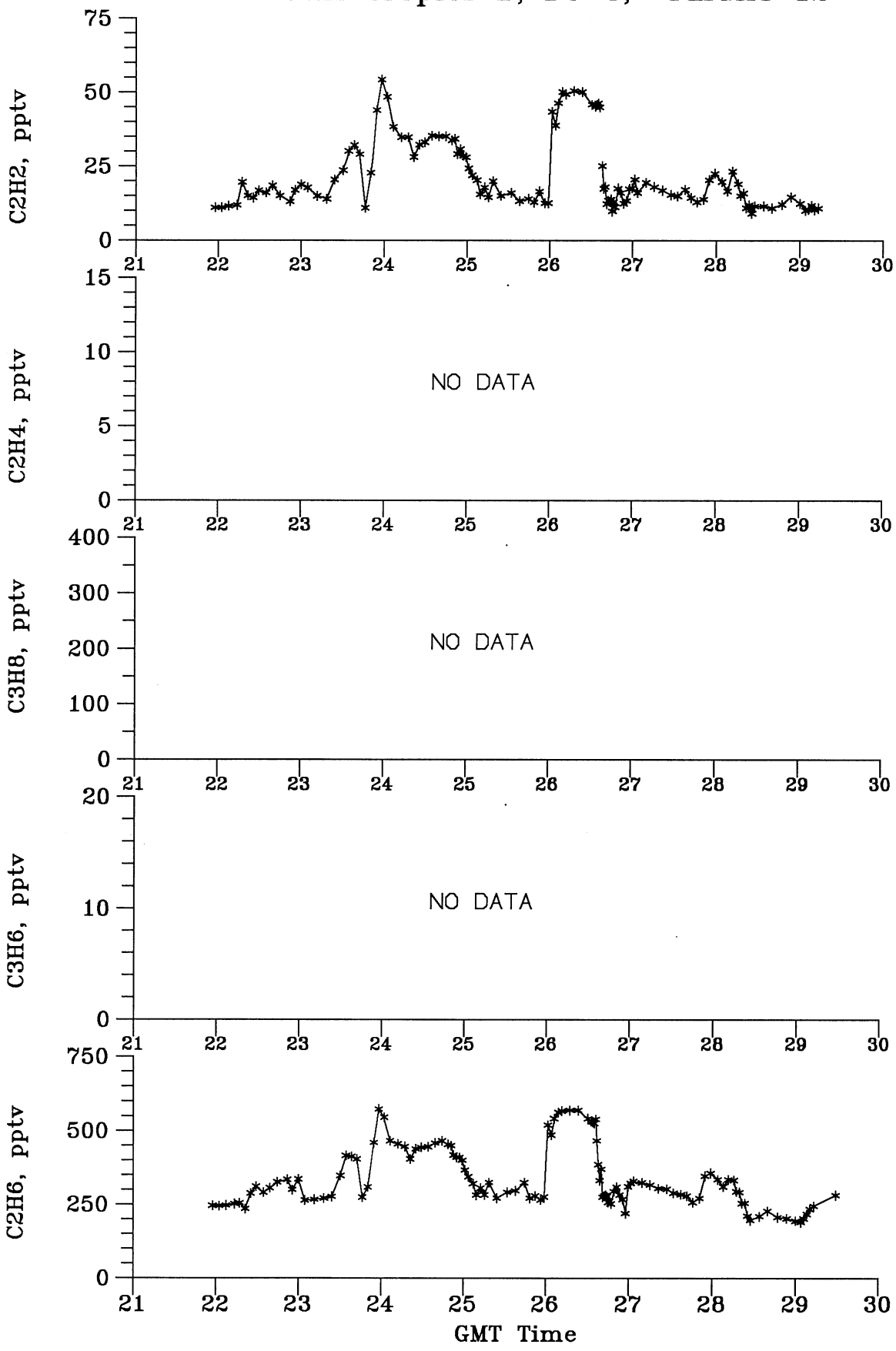
Photochemical Aging of Air

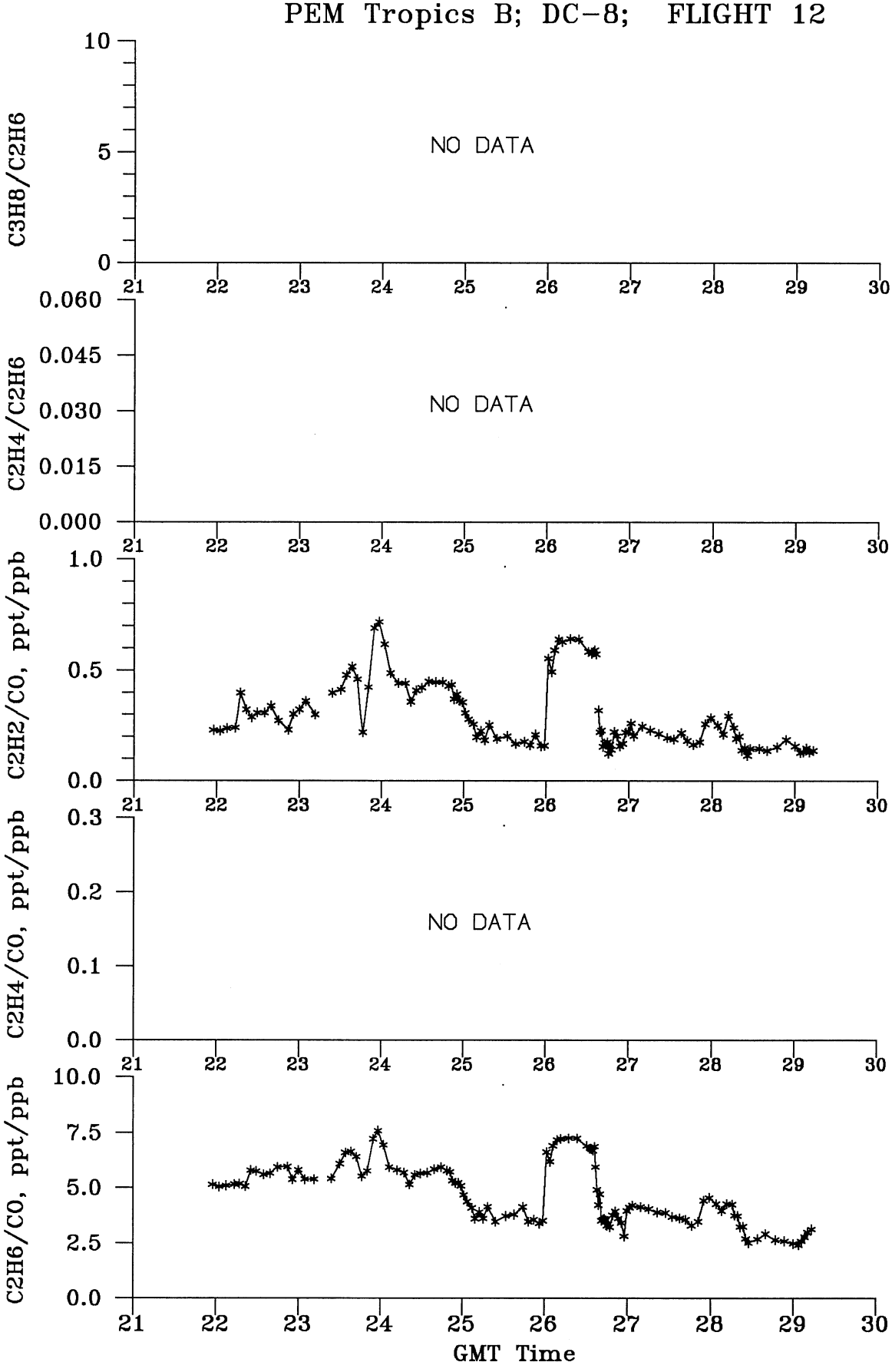
March 24, 1999

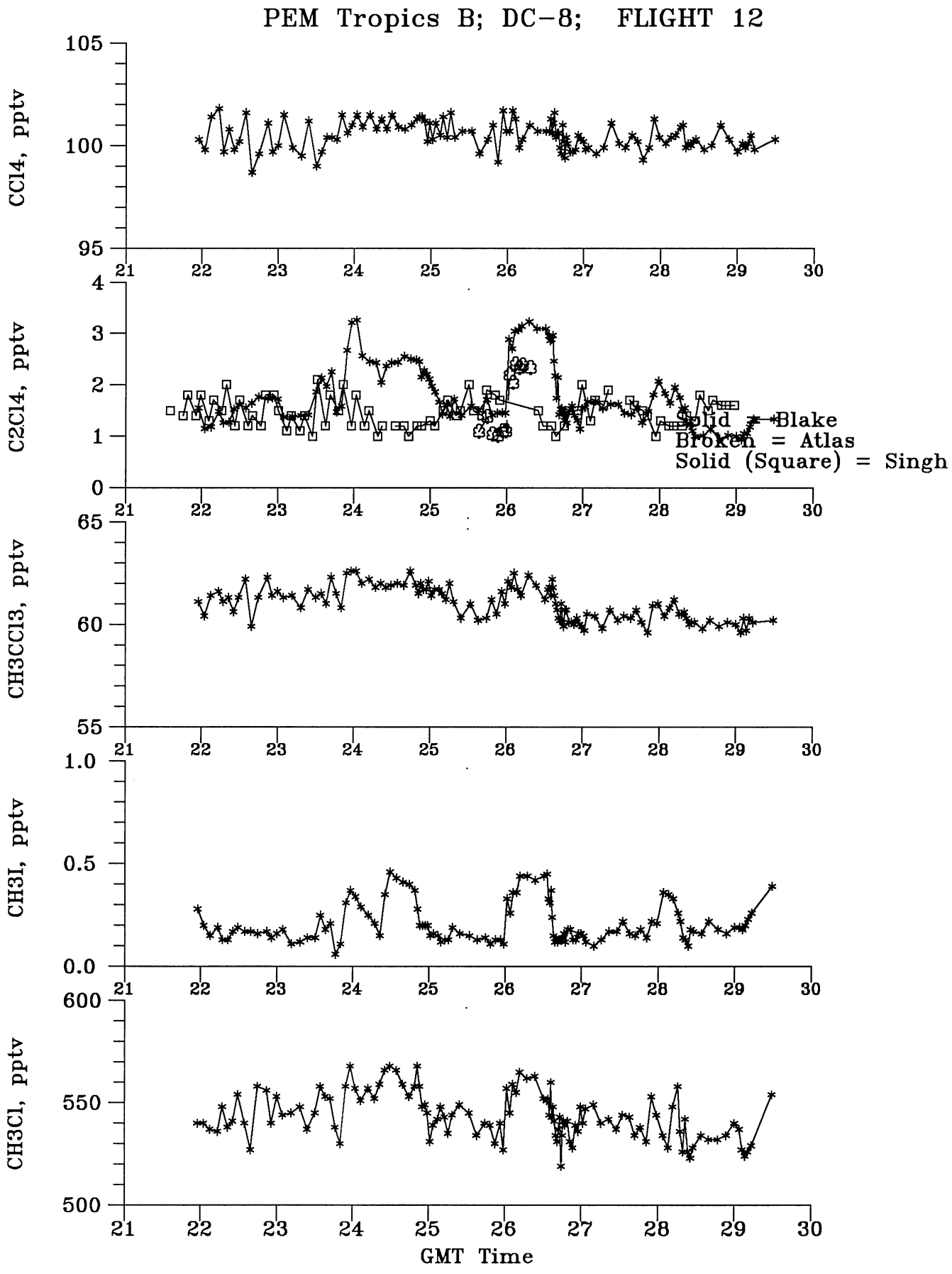

PEM Tropics B; DC-8; FLIGHT 12
North Latitude, deg.
0
-10
-20
165
170
175
180
East Longitude, deg.
Altitude, km
15
10
5
0
21
22
23
24
25
26
27
28
29
30
Temperature, C
40
20
0
-20
-40
-60
-80
Solid = Static Temp
Broken = Project Dew Pt.
Rel. Hum, percent
100
50
0
Water Vapor, ppmv
20000
10000
0
GMT Time

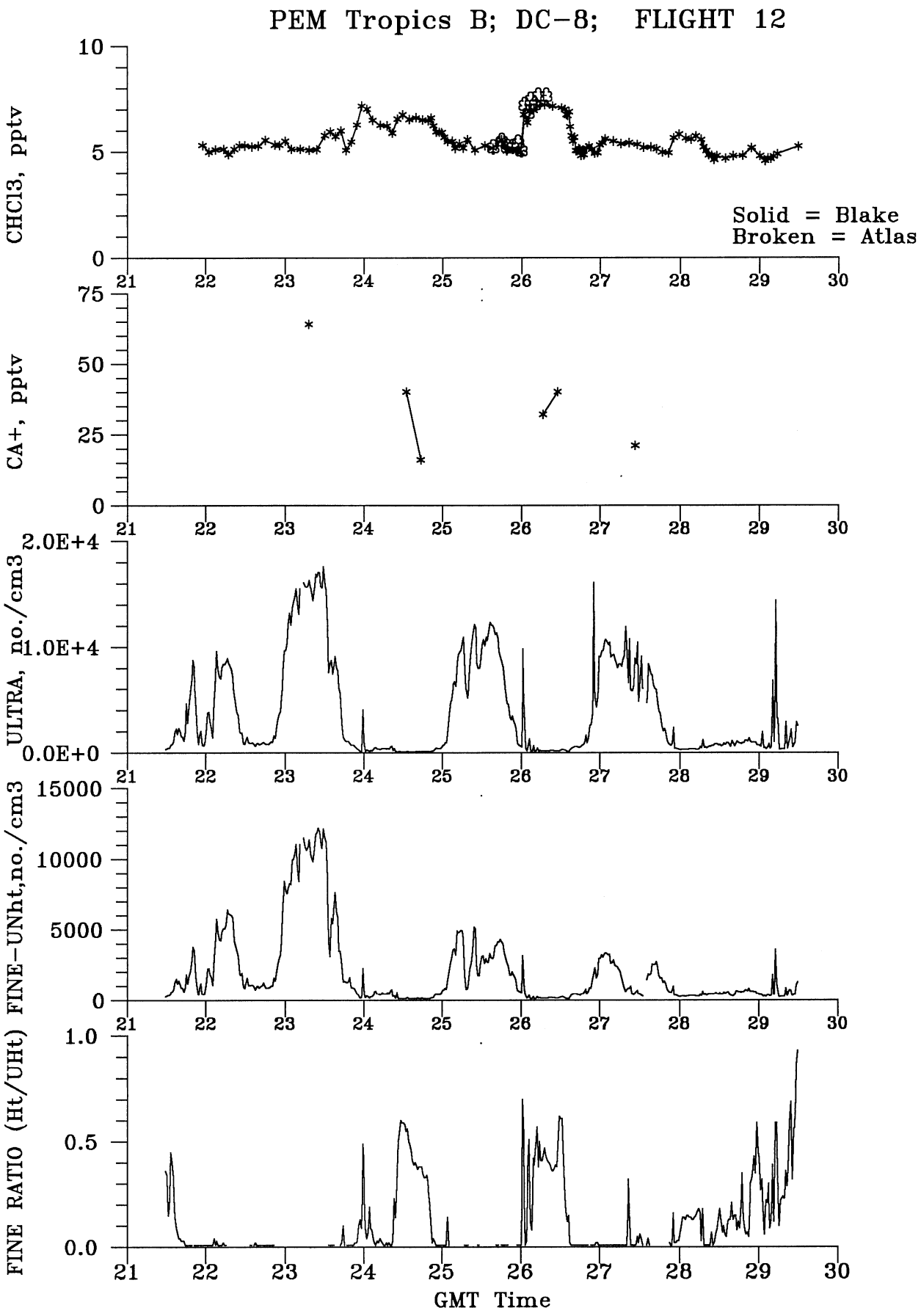

PEM Tropics B; DC-8; FLIGHT 12
O3, ppbv
32
24
16
8
0
CO, ppbv
80
70
60
50
40
30
CH4, ppbv
1800
1750
1700
CO2, ppmv
370
365
OH, pptv
0.50
0.25
0.00
21
22
23
24
25
26
27
28
29
30
GMT Time

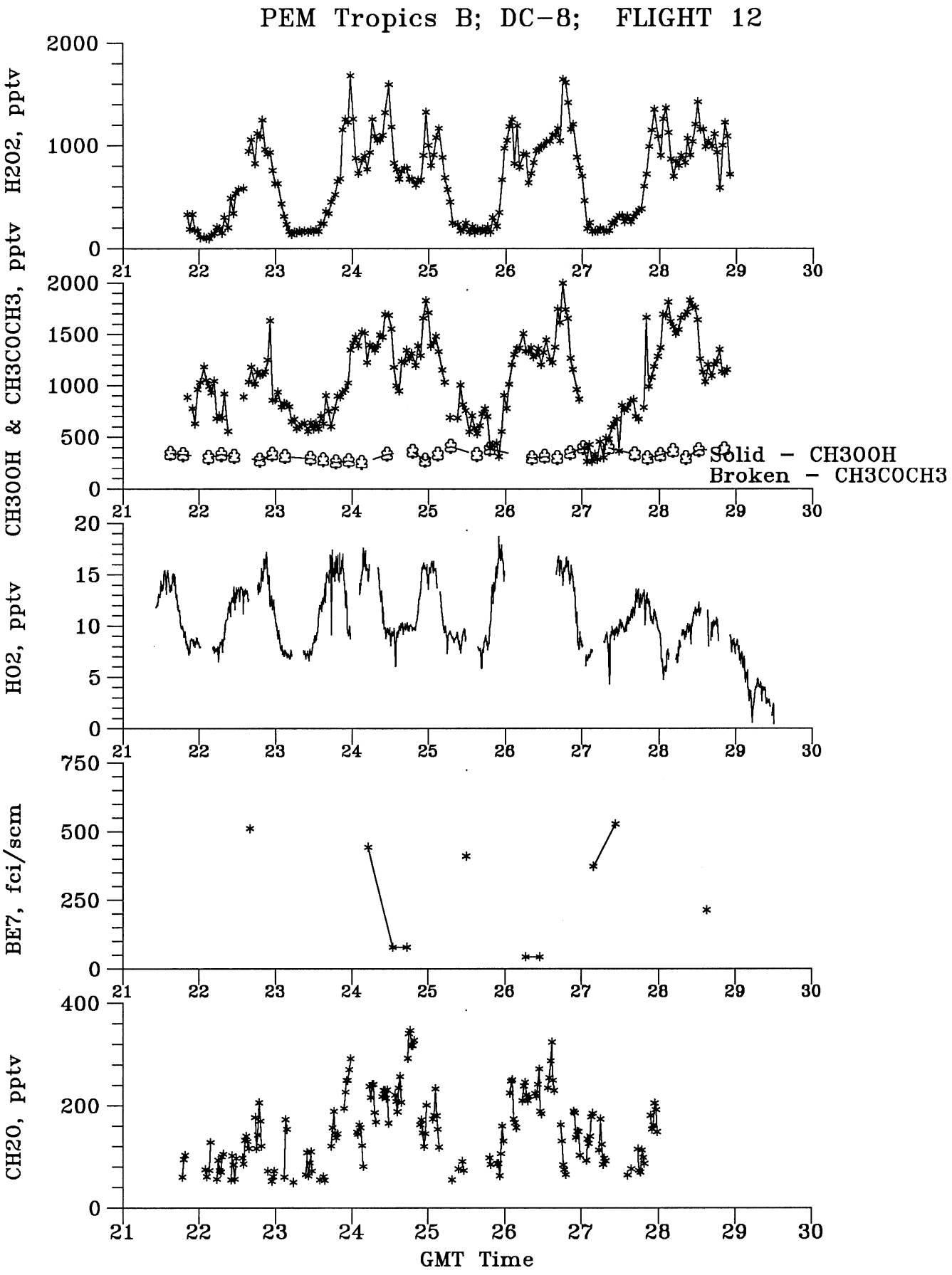

PEM Tropics B; DC-8; FLIGHT 12
NO, pptv
HNO3, pptv
NO2, pptv
SO2, pptv
DMS, pptv
GMT Time

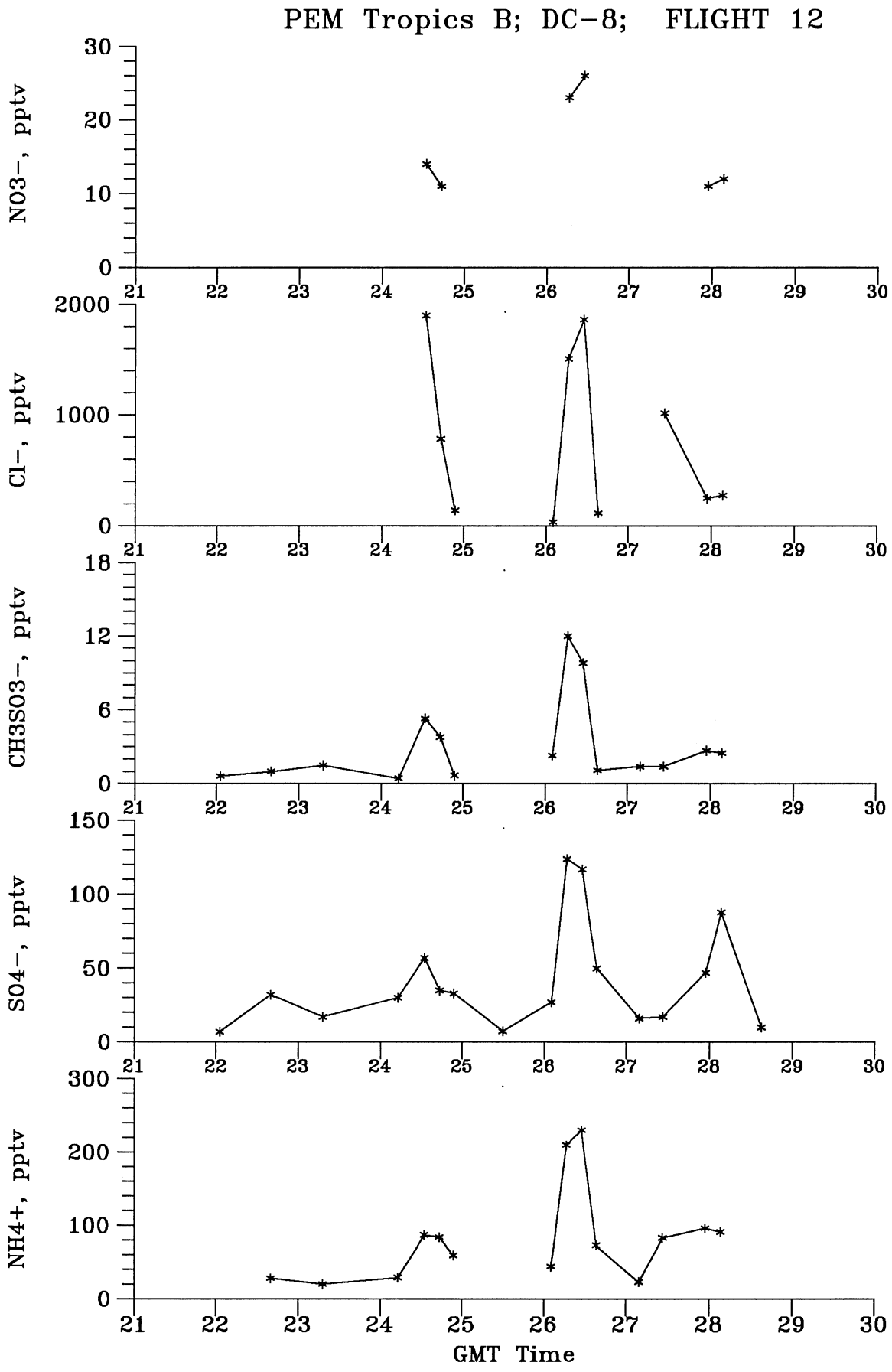

PEM Tropics B; DC-8; FLIGHT 12
C2H2, pptv
75
50
25
0
C2H4, pptv
15
10
5
0
NO DATA
C3H8, pptv
400
300
200
100
0
NO DATA
C3H6, pptv
20
10
0
NO DATA
C2H6, pptv
750
500
250
0
21
22
23
24
25
26
27
28
29
30
GMT Time

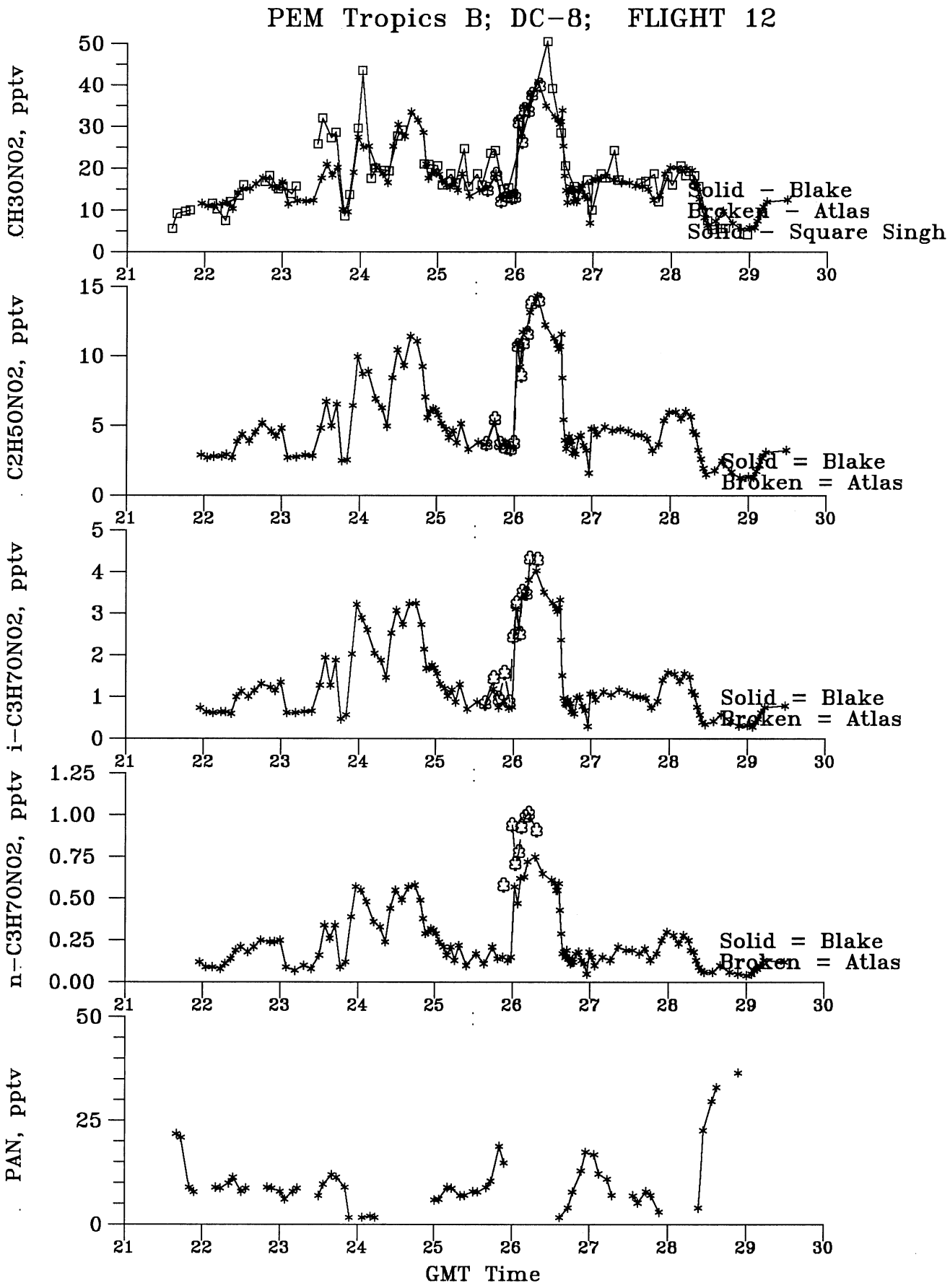

PEM Tropics B; DC-8; FLIGHT 12
C3H8/C2H6
10
5
0
NO DATA
C2H4/C2H6
0.060
0.045
0.030
0.015
0.000
NO DATA
C2H2/CO, ppt/ppb
1.0
0.5
0.0
C2H4/CO, ppt/ppb
0.3
0.2
0.1
0.0
NO DATA
C2H6/CO, ppt/ppb
10.0
7.5
5.0
2.5
0.0
21
22
23
24
25
26
27
28
29
30
GMT Time

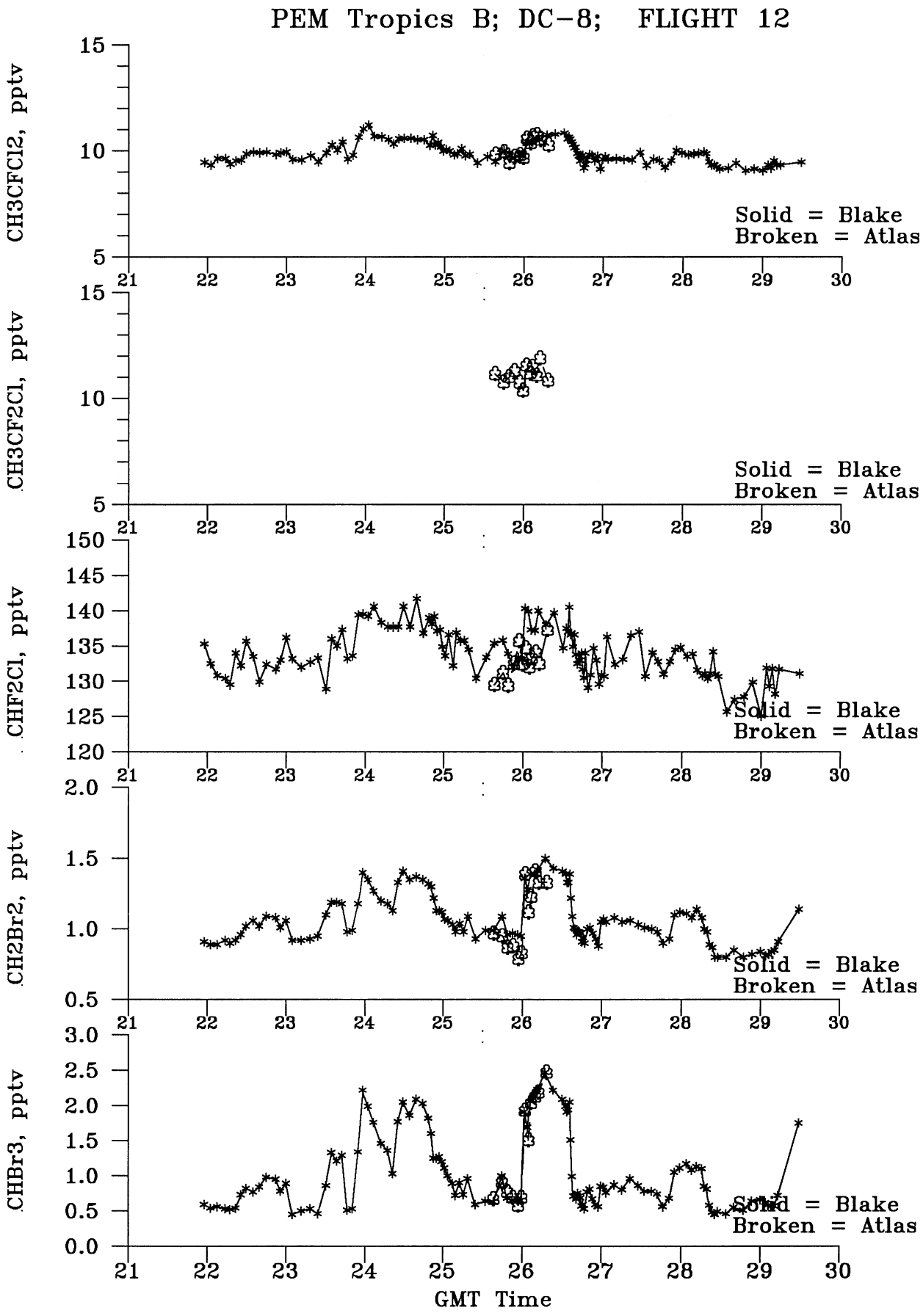

PEM Tropics B; DC-8; FLIGHT 12
CCl4, pptv
105
100
95
C2Cl4, pptv
4
3
2
1
0
Solid = Blake
Broken = Atlas
Solid (Square) = Singh
CH3CCl3, pptv
65
60
55
CH3I, pptv
1.0
0.5
0.0
CH3Cl, pptv
600
550
500
21
22
23
24
25
26
27
28
29
30
GMT Time

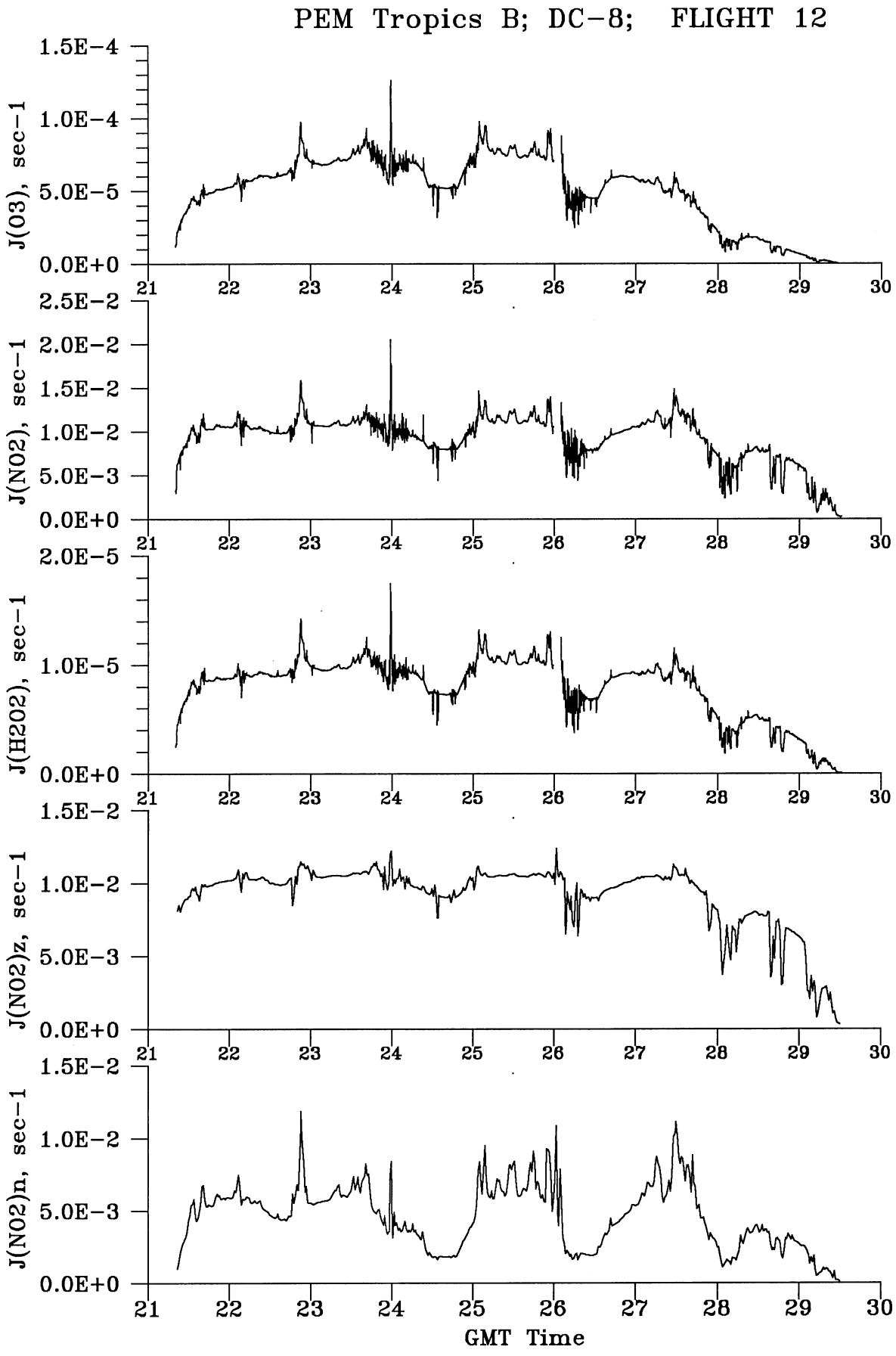

PEM Tropics B; DC-8; FLIGHT 12
CHCl3, pptv
Solid = Blake
Broken = Atlas
CA+, pptv
ULTRA, no./cm3
FINE-UNht,no./cm3
FINE RATIO (Ht/UHt)
GMT Time

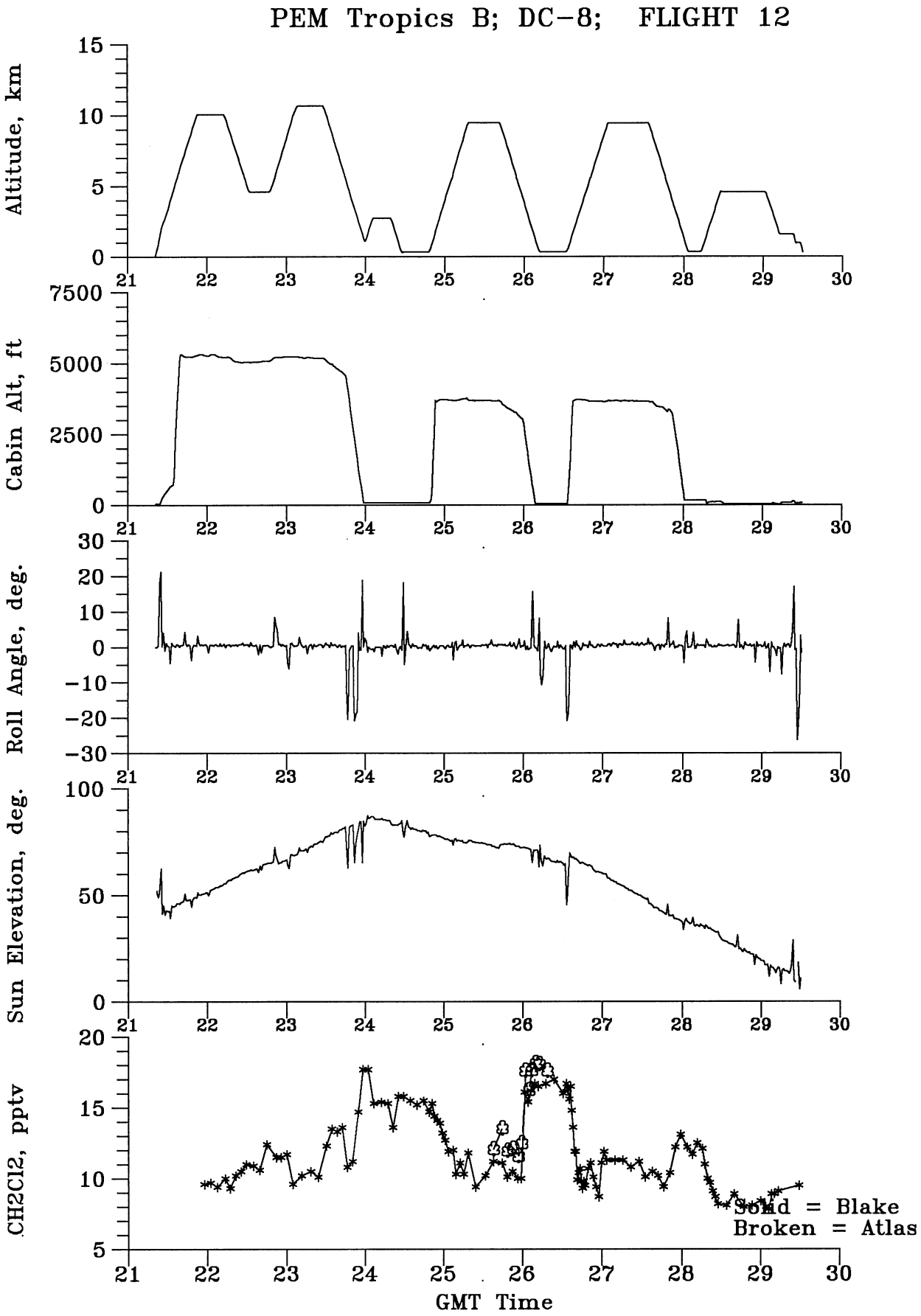

PEM Tropics B; DC-8; FLIGHT 12
H2O2, pptv
2000
1000
0
CH3OOH & CH3COCH3, pptv
2000
1500
1000
500
0
Solid - CH3OOH
Broken - CH3COCH3
HO2, pptv
20
15
10
5
0
BE7, fci/scm
750
500
250
0
CH2O, pptv
400
200
0
21
22
23
24
25
26
27
28
29
30
GMT Time


PEM Tropics B; DC-8; FLIGHT 12
NO3-, pptv
Cl-, pptv
CH3SO3-, pptv
SO4-, pptv
NH4+, pptv
GMT Time

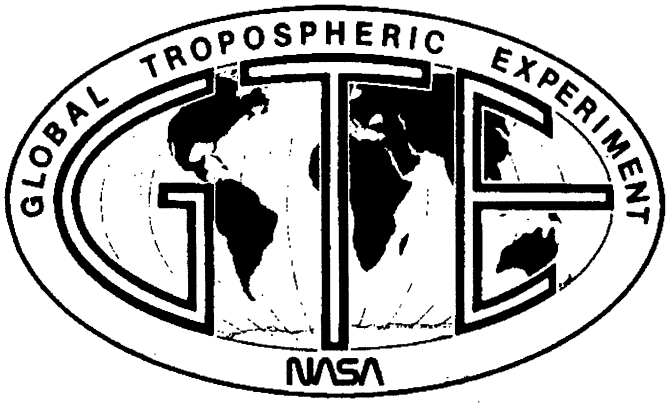

PEM Tropics B; DC-8; FLIGHT 12
CH3ONO2, pptv
Solid - Blake
Broken - Atlas
Solid - Square Singh
C2H5ONO2, pptv
Solid = Blake
Broken = Atlas
i-C3H7ONO2, pptv
Solid = Blake
Broken = Atlas
n-C3H7ONO2, pptv
Solid = Blake
Broken = Atlas
PAN, pptv
GMT Time


PEM Tropics B; DC-8; FLIGHT 12
CH3CFCl2, pptv
15
10
5
Solid = Blake
Broken = Atlas
CH3CF2Cl, pptv
15
10
5
Solid = Blake
Broken = Atlas
CHF2Cl, pptv
150
145
140
135
130
125
120
Solid = Blake
Broken = Atlas
CH2Br2, pptv
2.0
1.5
1.0
0.5
Solid = Blake
Broken = Atlas
CHBr3, pptv
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Solid = Blake
Broken = Atlas
21
22
23
24
25
26
27
28
29
30
GMT Time


PEM Tropics B; DC-8; FLIGHT 12
J(O3), sec-1
1.5E-4
1.0E-4
5.0E-5
0.0E+0
J(NO2), sec-1
2.5E-2
2.0E-2
1.5E-2
1.0E-2
5.0E-3
0.0E+0
J(H2O2), sec-1
2.0E-5
1.0E-5
0.0E+0
J(NO2)z, sec-1
1.5E-2
1.0E-2
5.0E-3
0.0E+0
J(NO2)n, sec-1
1.5E-2
1.0E-2
5.0E-3
0.0E+0
21
22
23
24
25
26
27
28
29
30
GMT Time


PEM Tropics B; DC-8; FLIGHT 12
Altitude, km
15
10
5
0
Cabin Alt, ft
7500
5000
2500
0
Roll Angle, deg.
30
20
10
0
−10
−20
−30
Sun Elevation, deg.
100
50
0
CH2Cl2, pptv
20
15
10
5
21
22
23
24
25
26
27
28
29
30
GMT Time
Solid = Blake
Broken = Atlas

PLOTS OF FINAL CHEMICAL DATA



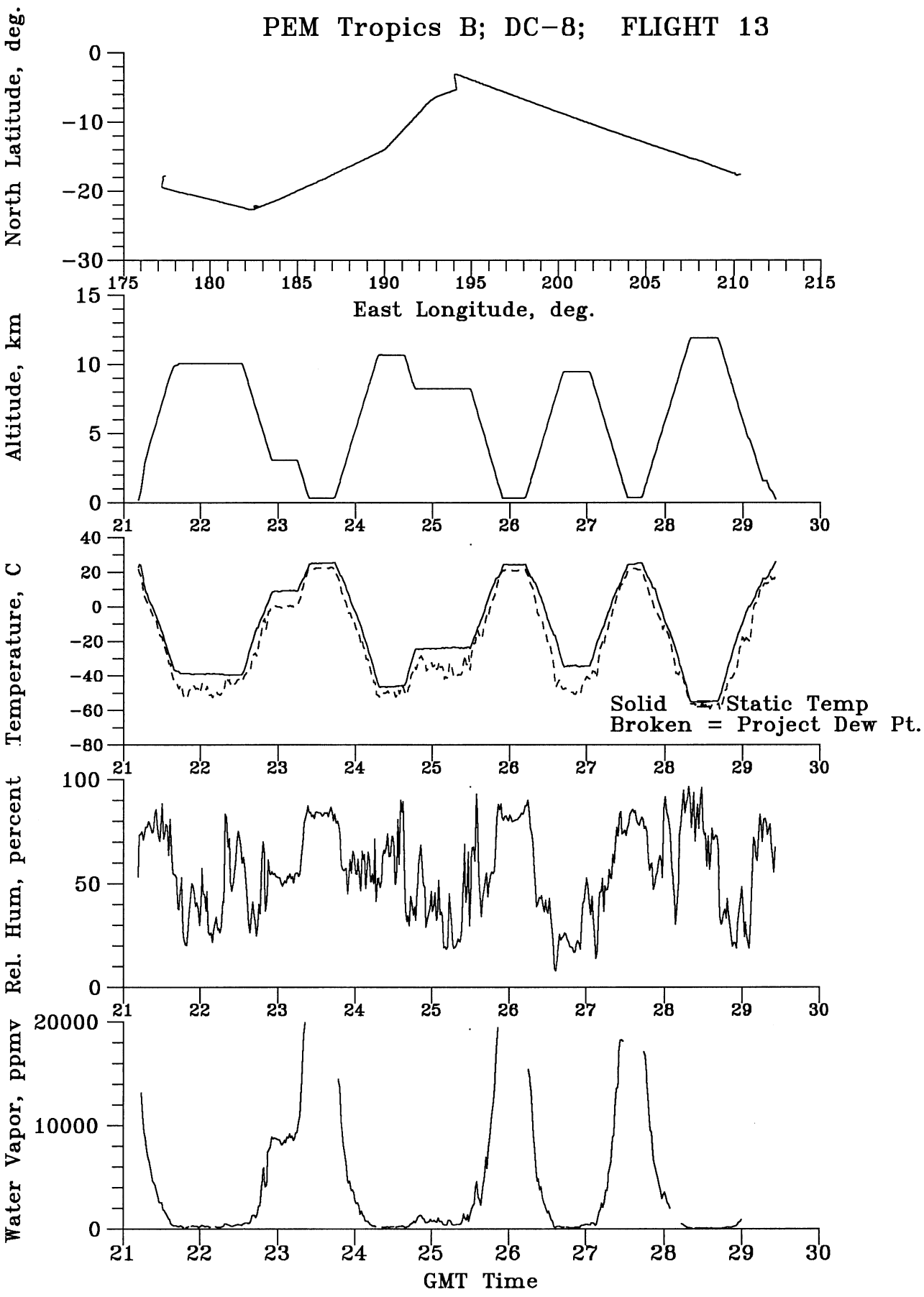
PEM-TROPICS B

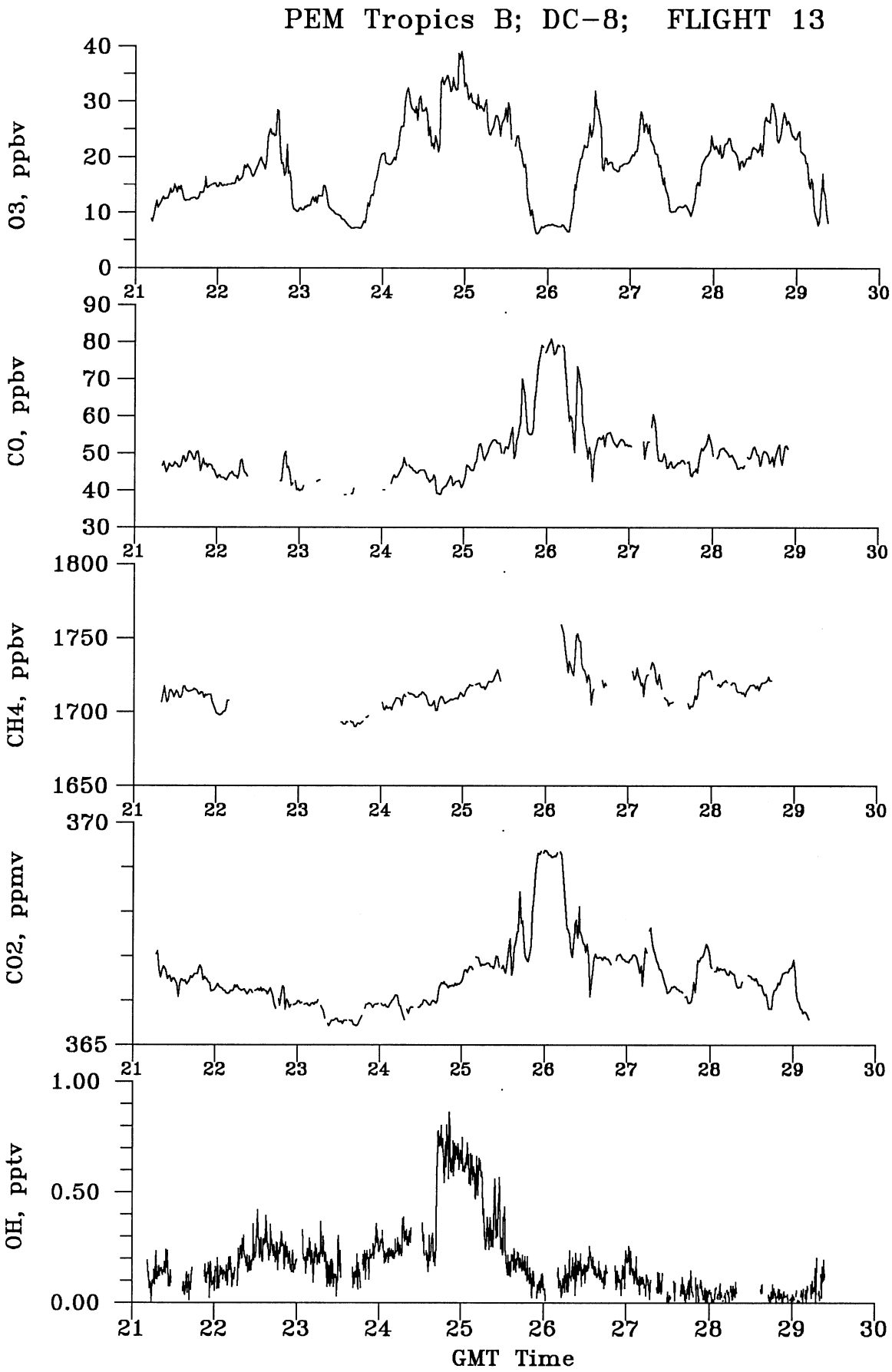
Flight 13D

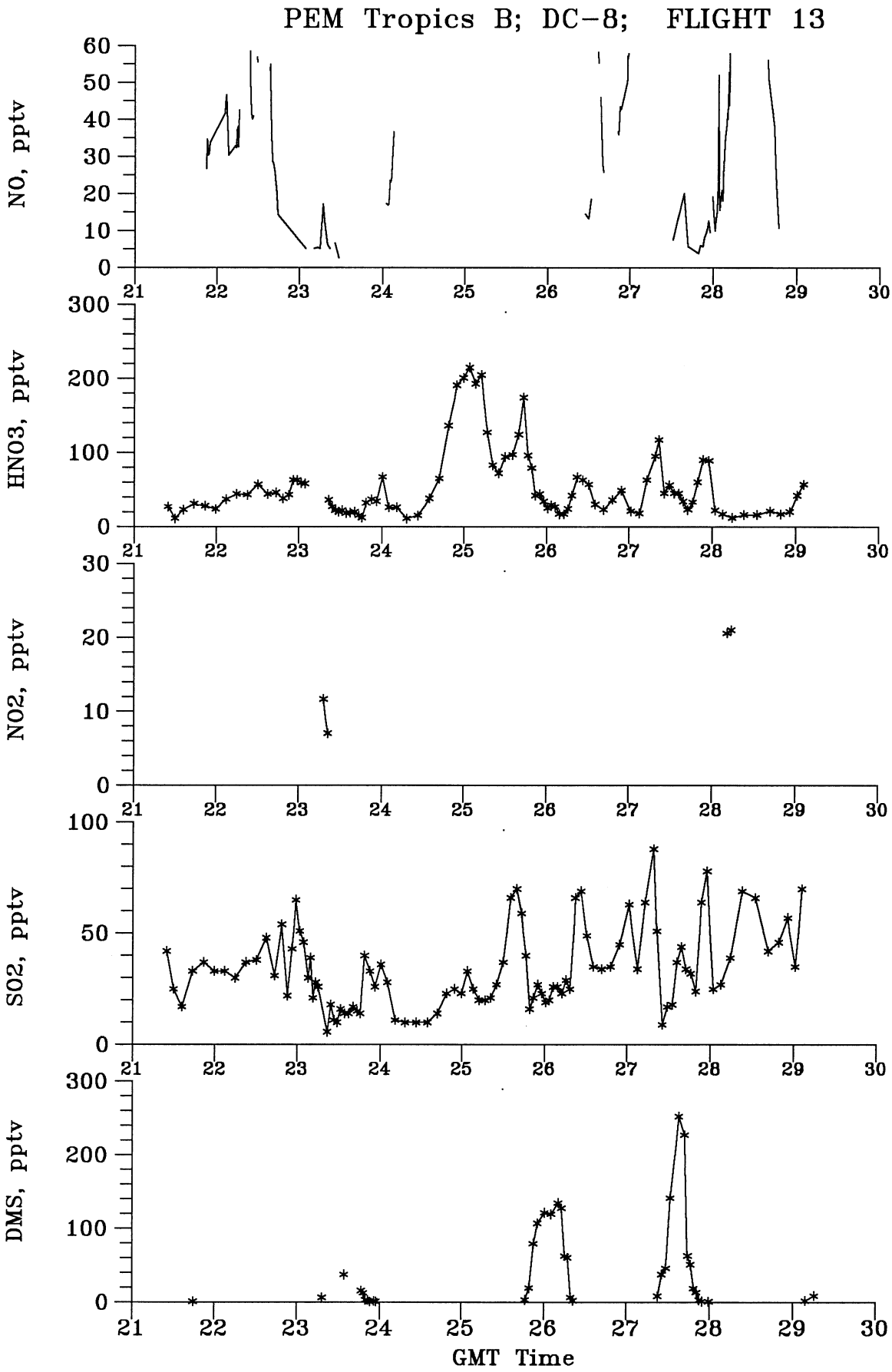
Transit: Fiji to Tahiti

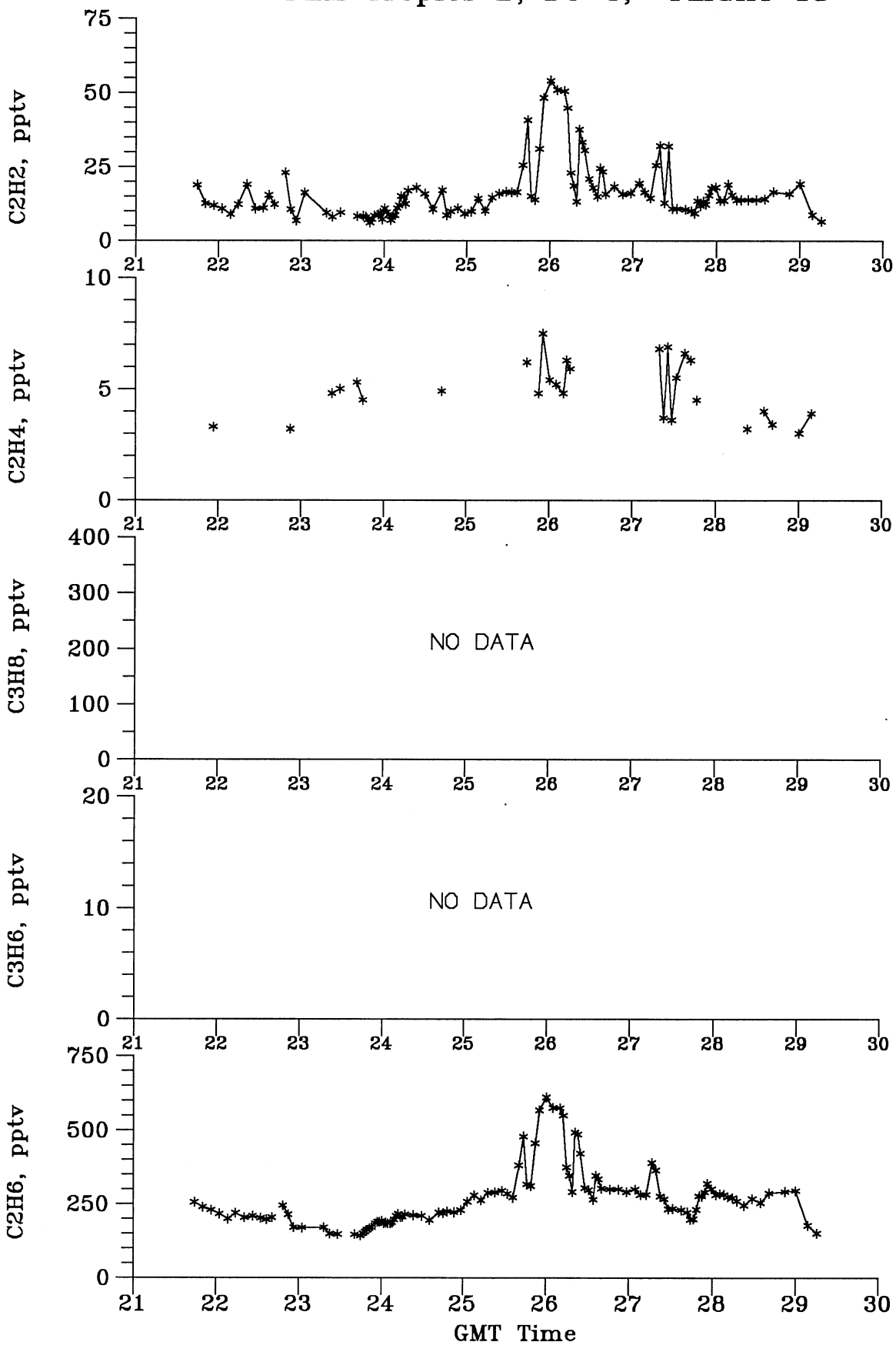
Equatorial Survey

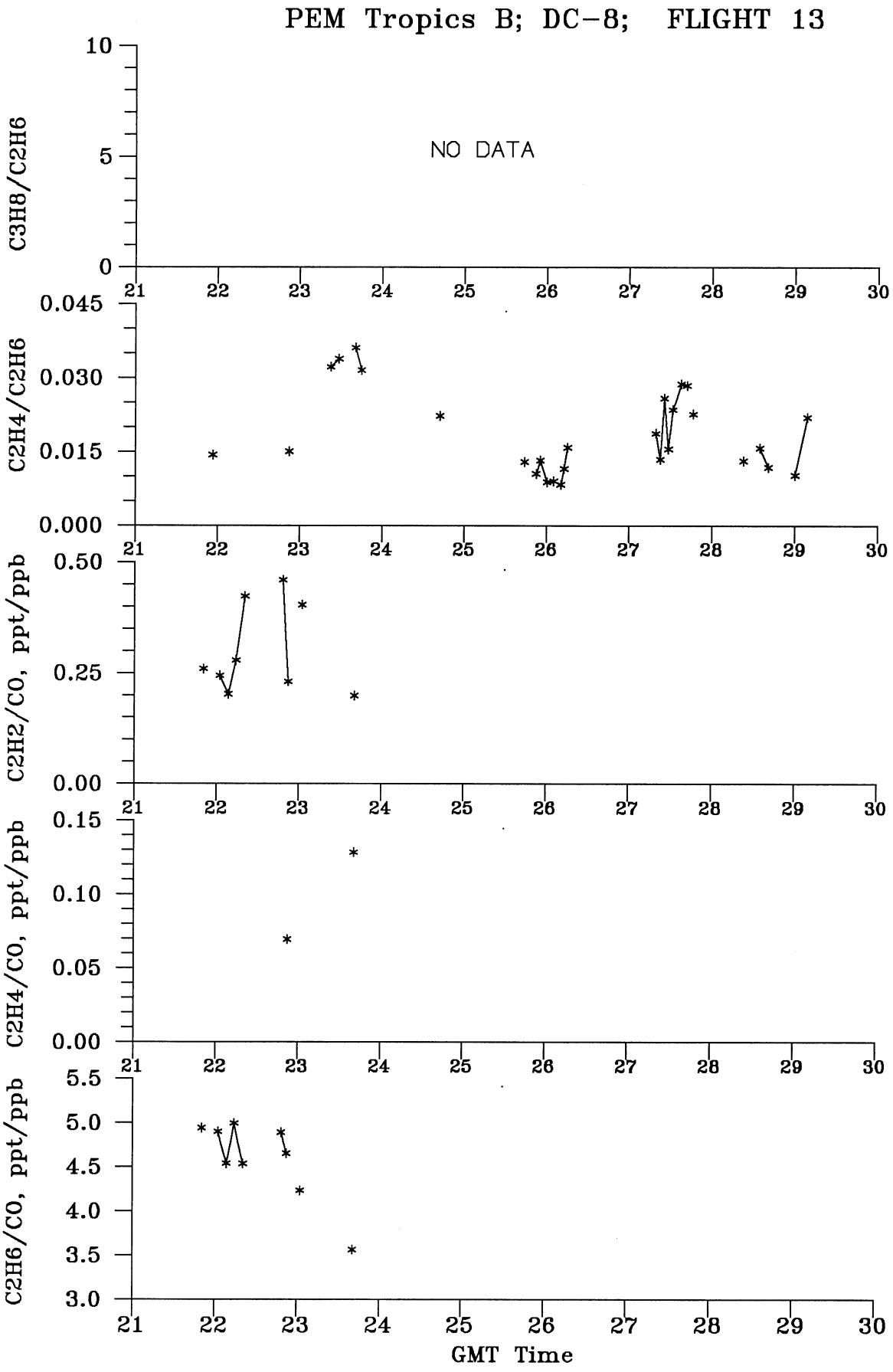
March 26, 1999

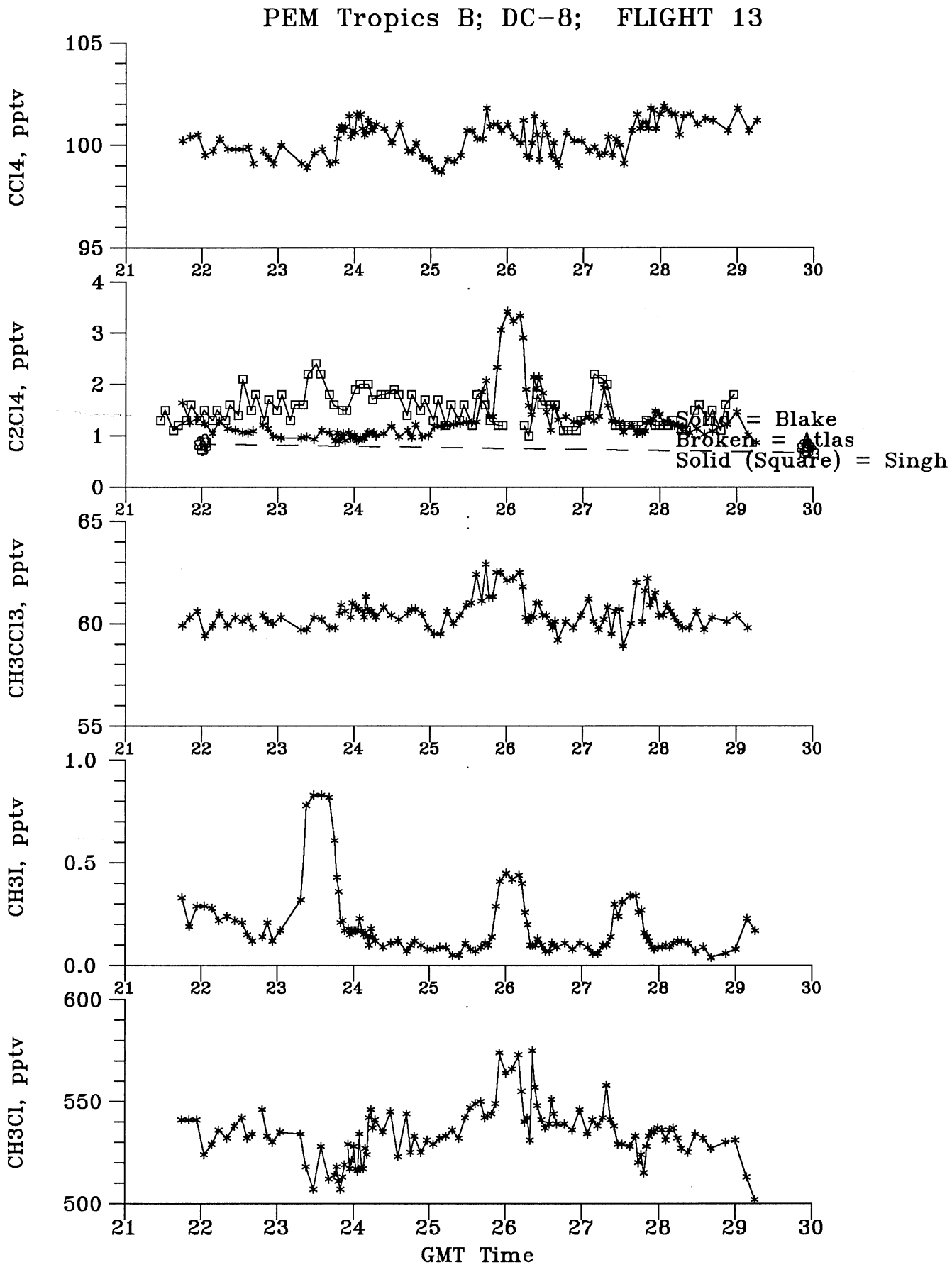

PEM Tropics B; DC-8; FLIGHT 13
North Latitude, deg.
0
-10
-20
-30
175
180
185
190
195
200
205
210
215
East Longitude, deg.
Altitude, km
15
10
5
0
21
22
23
24
25
26
27
28
29
30
Temperature, C
40
20
0
-20
-40
-60
-80
Solid = Static Temp
Broken = Project Dew Pt.
Rel. Hum, percent
100
50
0
Water Vapor, ppmv
20000
10000
0
GMT Time

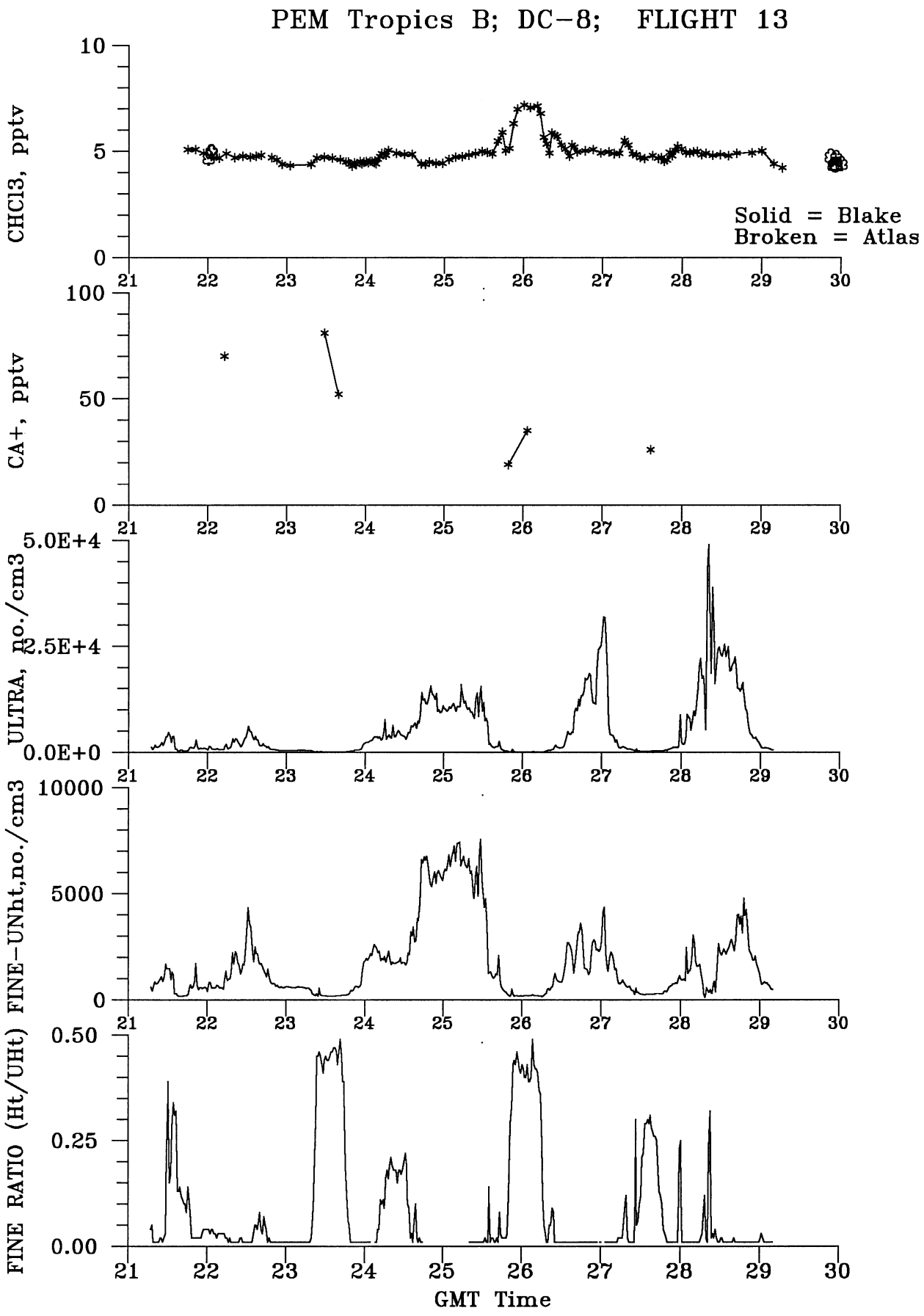

PEM Tropics B; DC-8; FLIGHT 13
O3, ppbv
0
10
20
30
40
CO, ppbv
30
40
50
60
70
80
90
CH4, ppbv
1650
1700
1750
1800
CO2, ppmv
365
370
OH, pptv
0.00
0.50
1.00
21
22
23
24
25
26
27
28
29
30
GMT Time

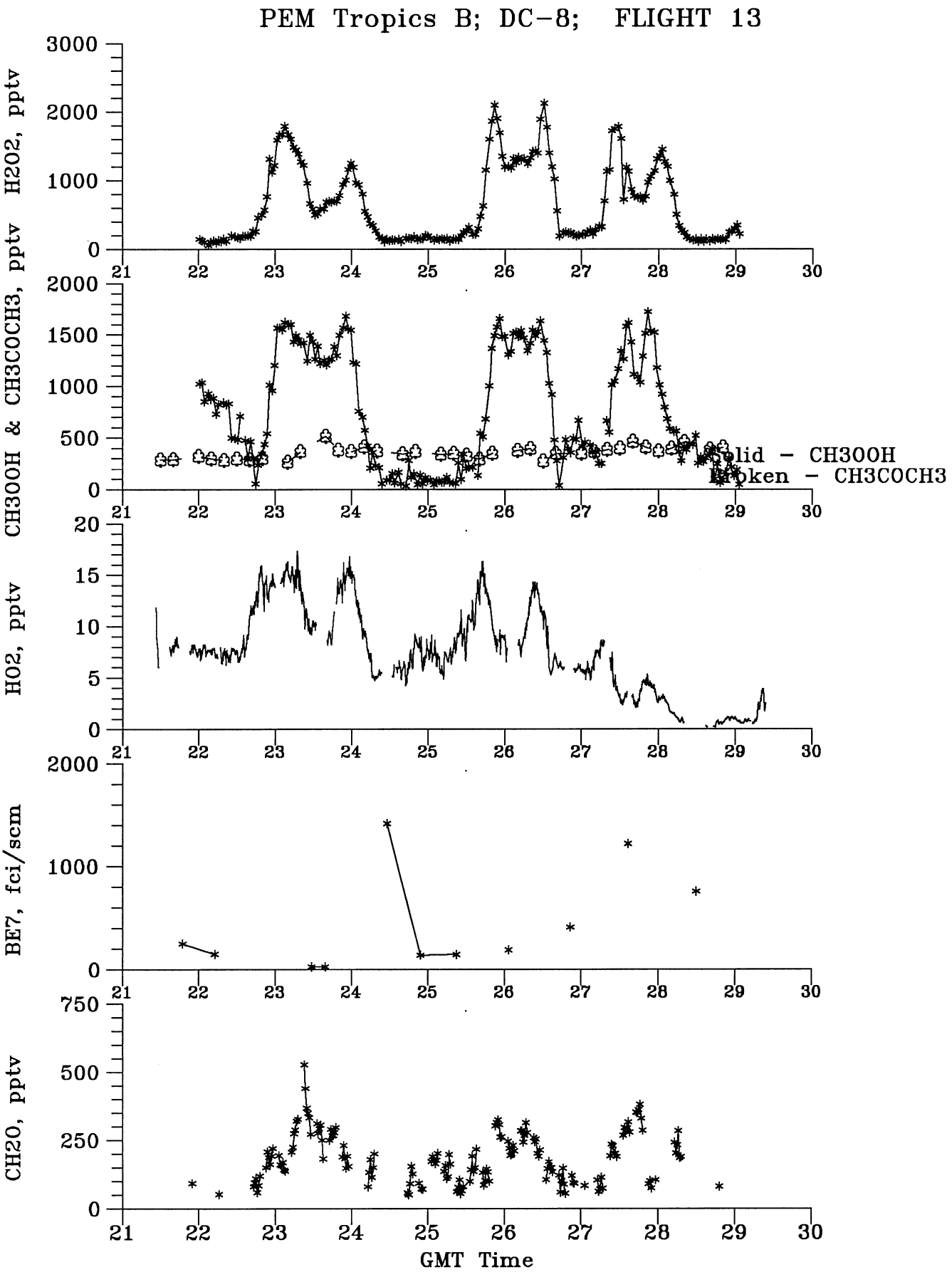

PEM Tropics B; DC-8; FLIGHT 13
NO, pptv
HNO3, pptv
NO2, pptv
SO2, pptv
DMS, pptv
GMT Time

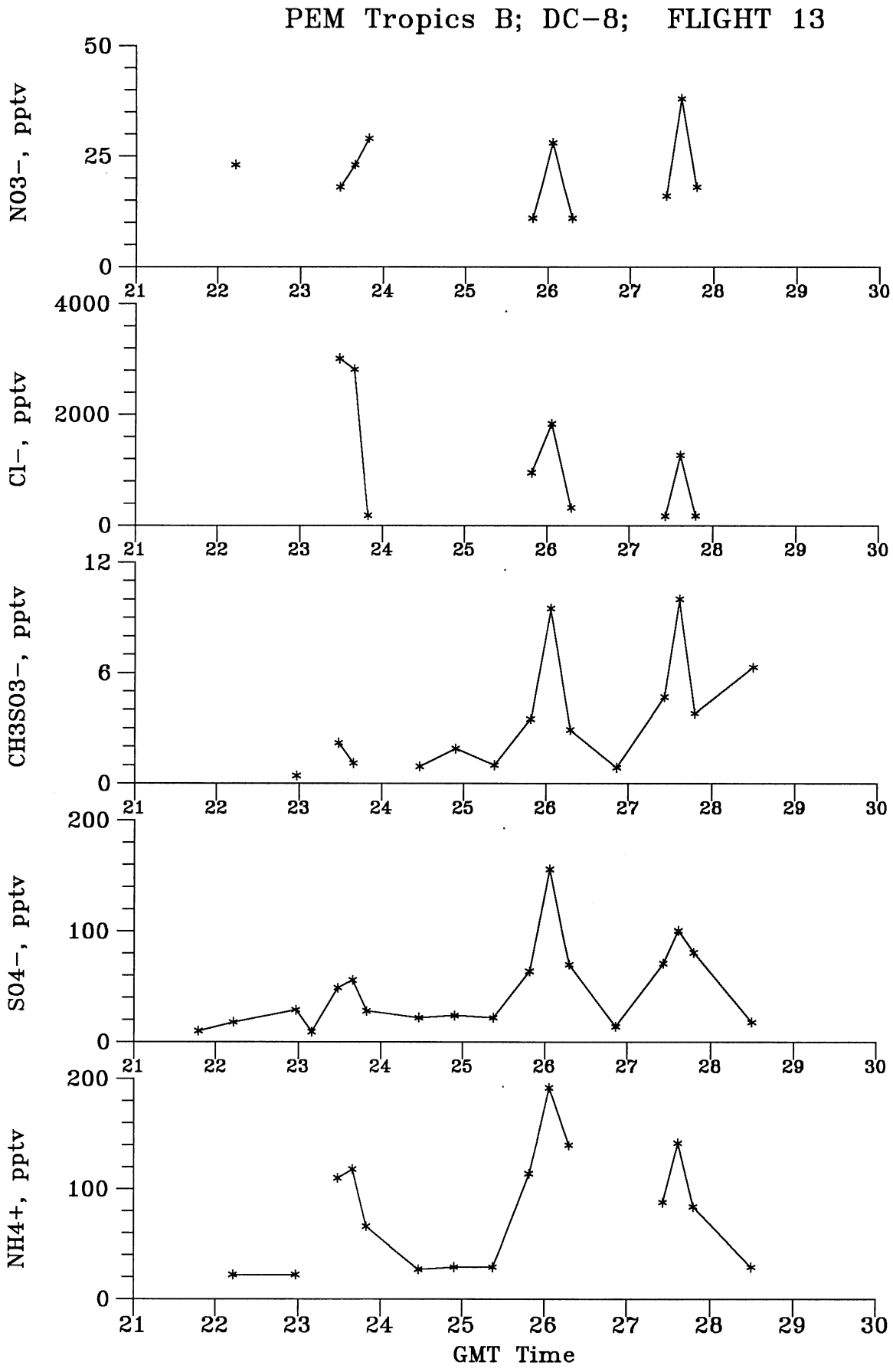

PEM Tropics B; DC-8; FLIGHT 13
C2H2, pptv
75
50
25
0
C2H4, pptv
10
5
0
C3H8, pptv
400
300
200
100
0
NO DATA
C3H6, pptv
20
10
0
NO DATA
C2H6, pptv
750
500
250
0
21
22
23
24
25
26
27
28
29
30
GMT Time

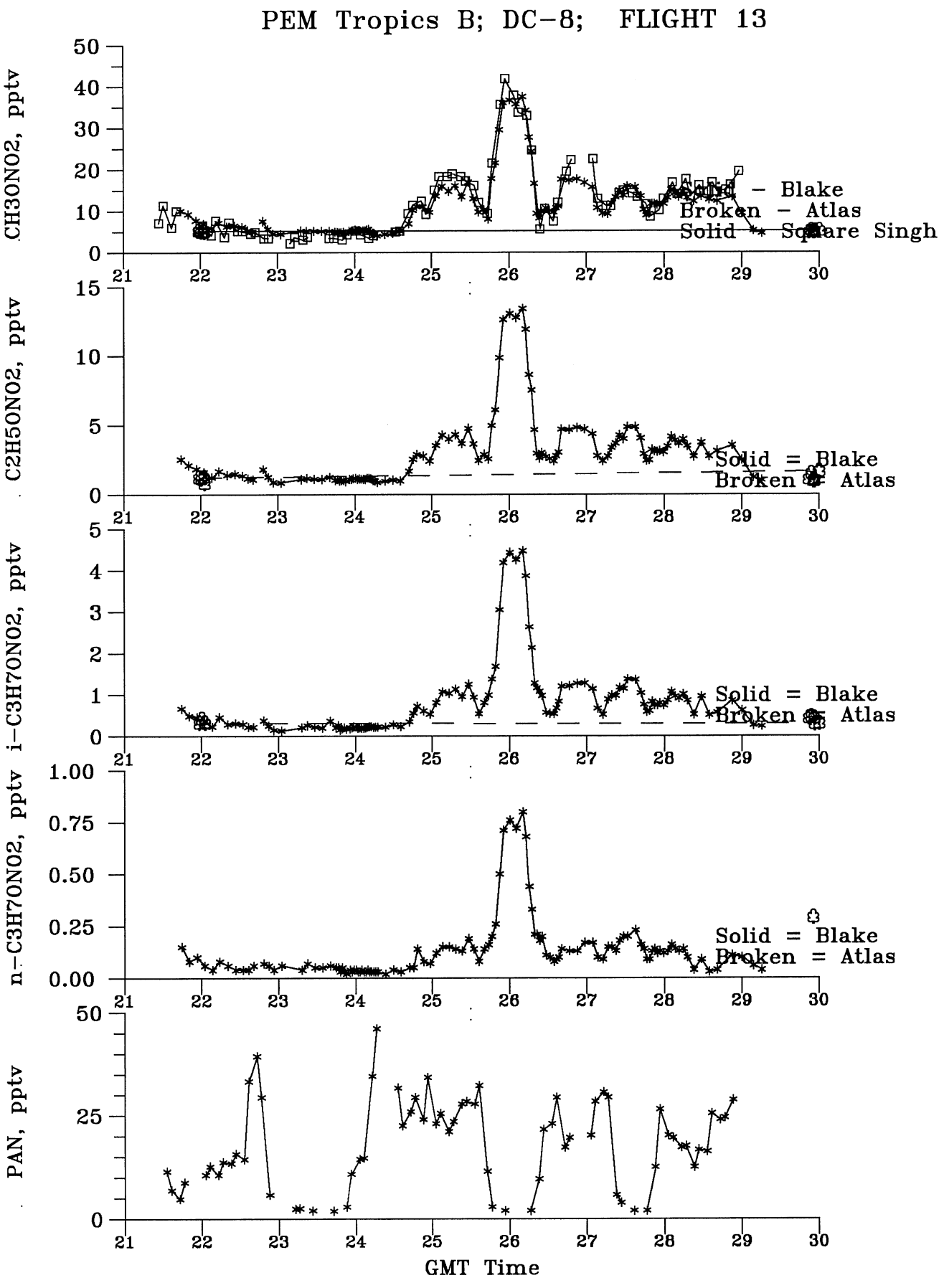

PEM Tropics B; DC-8; FLIGHT 13
C3H8/C2H6
NO DATA
C2H4/C2H6
C2H2/CO, ppt/ppb
C2H4/CO, ppt/ppb
C2H6/CO, ppt/ppb
GMT Time

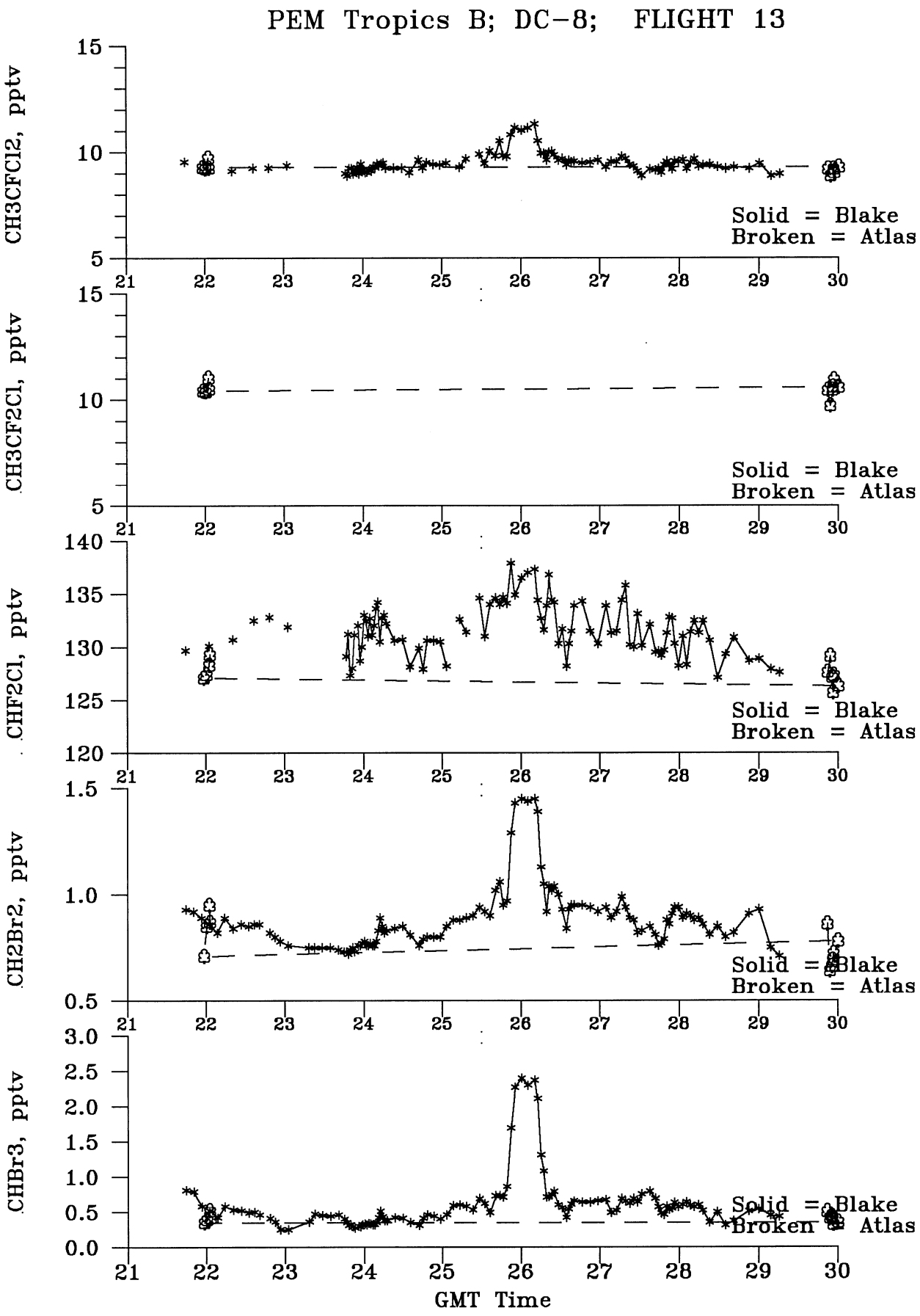

PEM Tropics B; DC-8; FLIGHT 13
CCl4, pptv
105
100
95
C2Cl4, pptv
4
3
2
1
0
Solid = Blake
Broken = Atlas
Solid (Square) = Singh
CH3CCl3, pptv
65
60
55
CH3I, pptv
1.0
0.5
0.0
CH3Cl, pptv
600
550
500
21
22
23
24
25
26
27
28
29
30
GMT Time

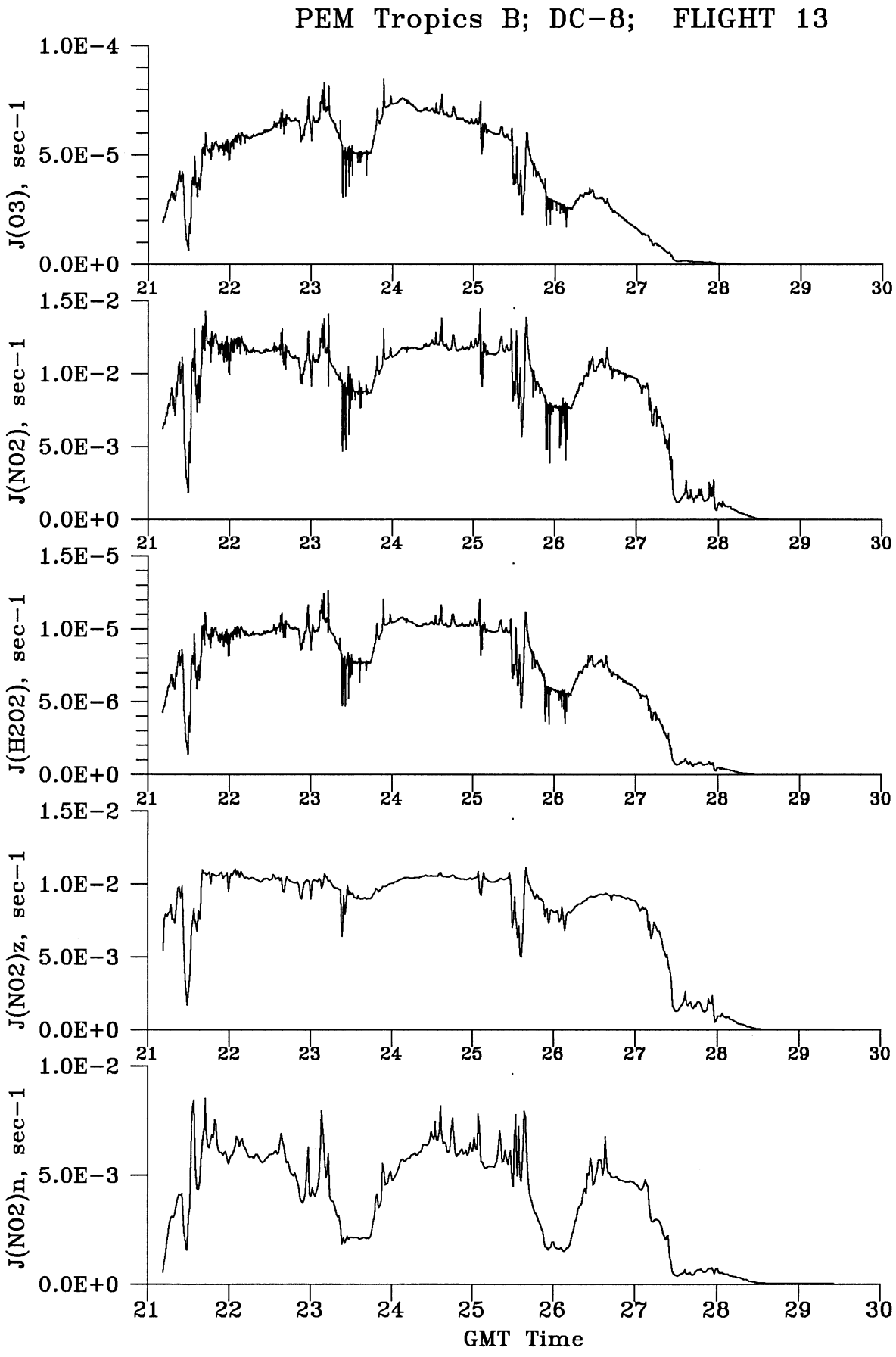

PEM Tropics B; DC-8; FLIGHT 13
CHCl3, pptv
Solid = Blake
Broken = Atlas
CA+, pptv
ULTRA, no./cm3
FINE-UNht,no./cm3
FINE RATIO (Ht/UHt)
GMT Time

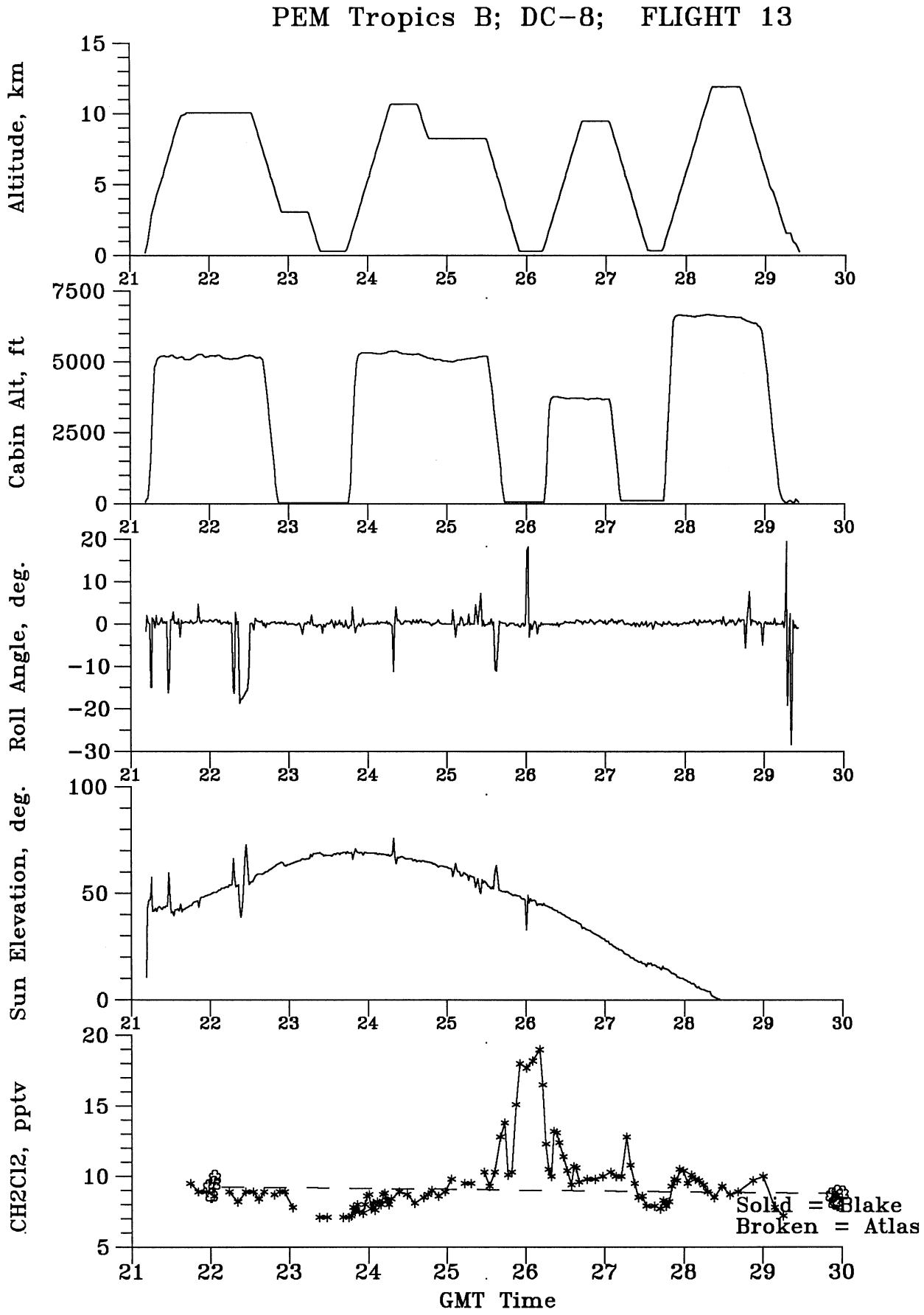

PEM Tropics B; DC-8; FLIGHT 13
H2O2, pptv
CH3OOH & CH3COCH3, pptv
Solid - CH3OOH
Broken - CH3COCH3
HO2, pptv
BE7, fci/scm
CH2O, pptv
GMT Time


PEM Tropics B; DC-8; FLIGHT 13
NO3-, pptv
50
25
0
Cl-, pptv
4000
2000
0
CH3SO3-, pptv
12
6
0
SO4-, pptv
200
100
0
NH4+, pptv
200
100
0
21
22
23
24
25
26
27
28
29
30
GMT Time

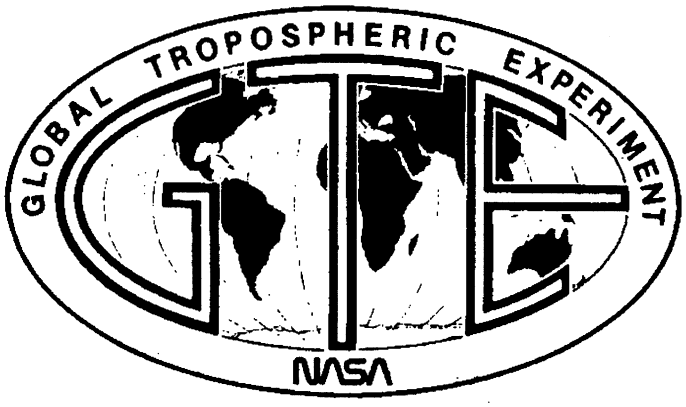

PEM Tropics B; DC-8; FLIGHT 13
CH3ONO2, pptv
Solid - Blake
Broken - Atlas
Solid - Square Singh
C2H5ONO2, pptv
Solid = Blake
Broken = Atlas
i-C3H7ONO2, pptv
Solid = Blake
Broken = Atlas
n-C3H7ONO2, pptv
Solid = Blake
Broken = Atlas
PAN, pptv
GMT Time


PEM Tropics B; DC-8; FLIGHT 13
CH3CFCl2, pptv
15
10
5
Solid = Blake
Broken = Atlas
CH3CF2Cl, pptv
15
10
5
Solid = Blake
Broken = Atlas
CHF2Cl, pptv
140
135
130
125
120
Solid = Blake
Broken = Atlas
CH2Br2, pptv
1.5
1.0
0.5
Solid = Blake
Broken = Atlas
CHBr3, pptv
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Solid = Blake
Broken = Atlas
21
22
23
24
25
26
27
28
29
30
GMT Time


PEM Tropics B; DC-8; FLIGHT 13
J(O3), sec-1
1.0E-4
5.0E-5
0.0E+0
J(NO2), sec-1
1.5E-2
1.0E-2
5.0E-3
0.0E+0
J(H2O2), sec-1
1.5E-5
1.0E-5
5.0E-6
0.0E+0
J(NO2)z, sec-1
1.5E-2
1.0E-2
5.0E-3
0.0E+0
J(NO2)n, sec-1
1.0E-2
5.0E-3
0.0E+0
21
22
23
24
25
26
27
28
29
30
GMT Time


PEM Tropics B; DC-8; FLIGHT 13
Altitude, km
15
10
5
0
Cabin Alt, ft
7500
5000
2500
0
Roll Angle, deg.
20
10
0
−10
−20
−30
Sun Elevation, deg.
100
50
0
CH2Cl2, pptv
20
15
10
5
21
22
23
24
25
26
27
28
29
30
GMT Time
Solid = Blake
Broken = Atlas

PLOTS OF FINAL CHEMICAL DATA



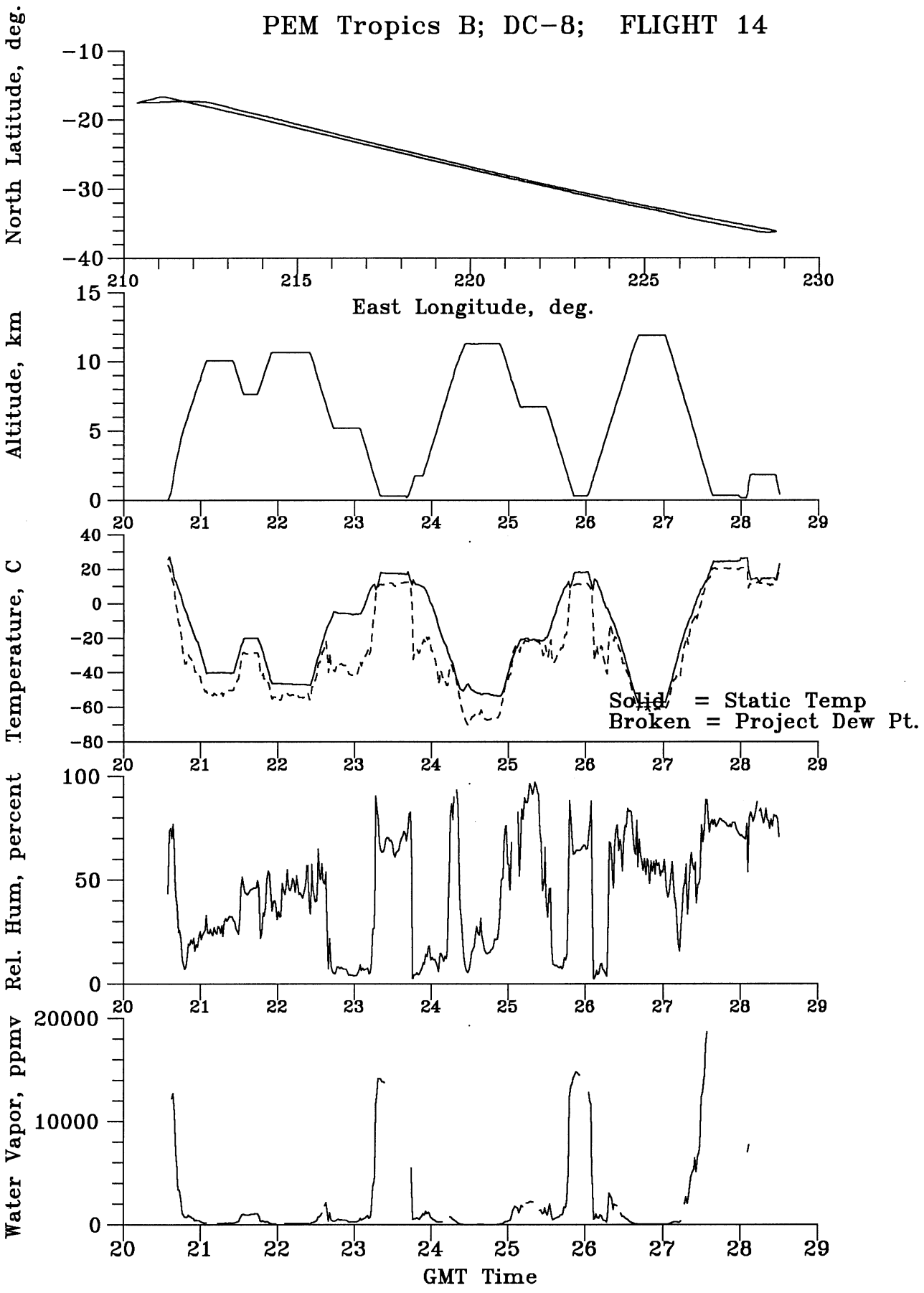
PEM-TROPICS B

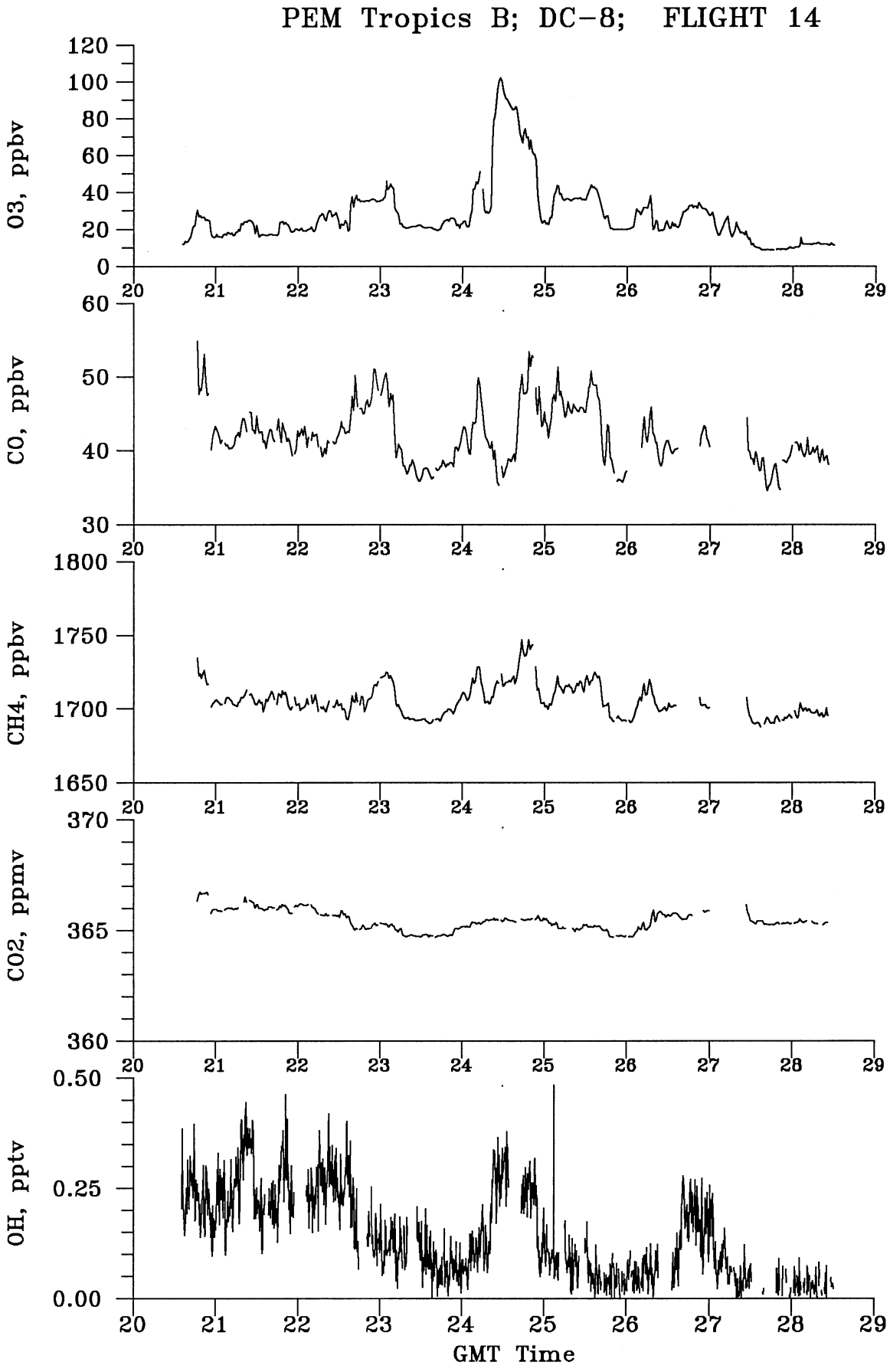
Flight 14D

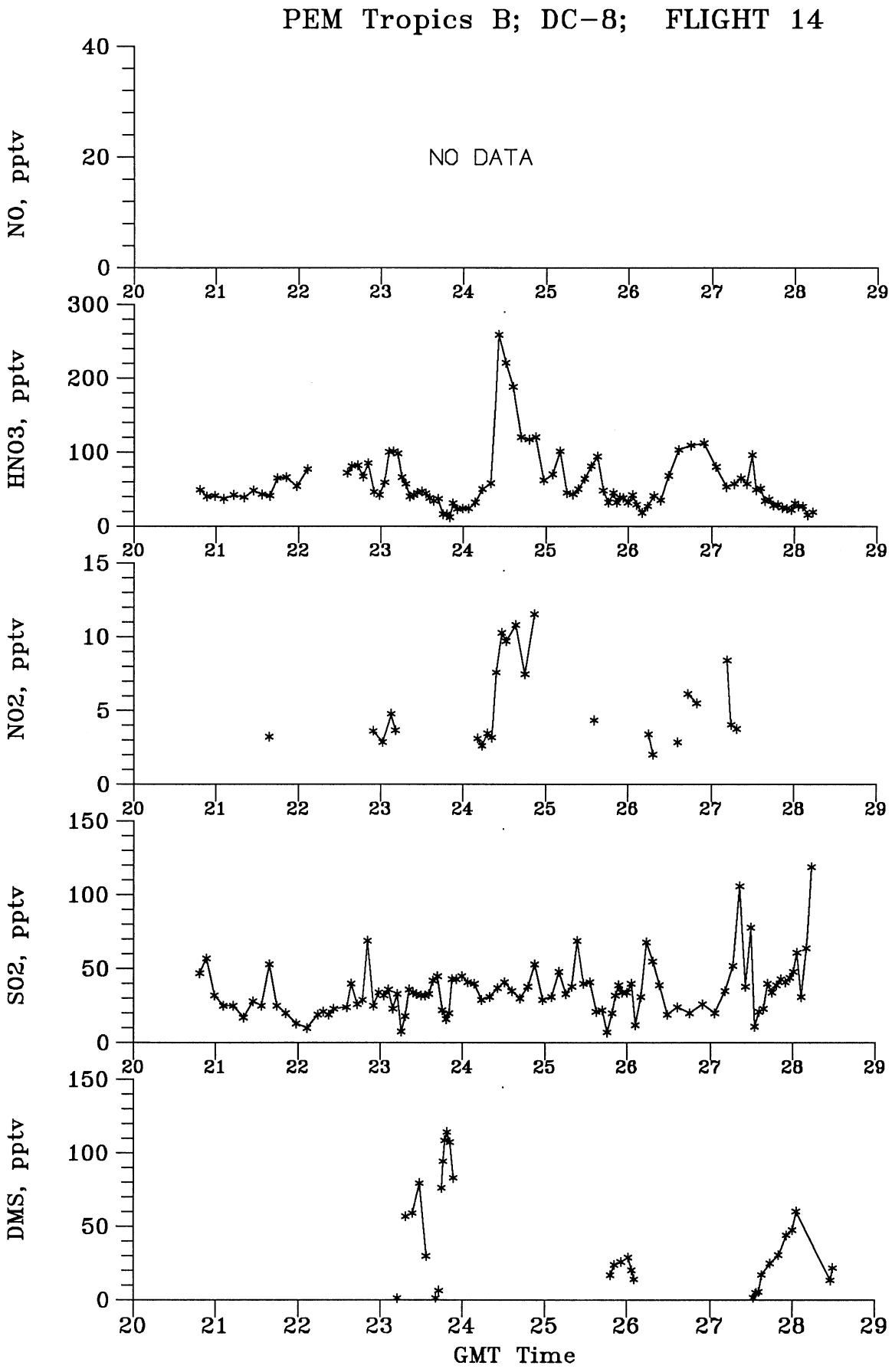
Local: Tahiti No. 1

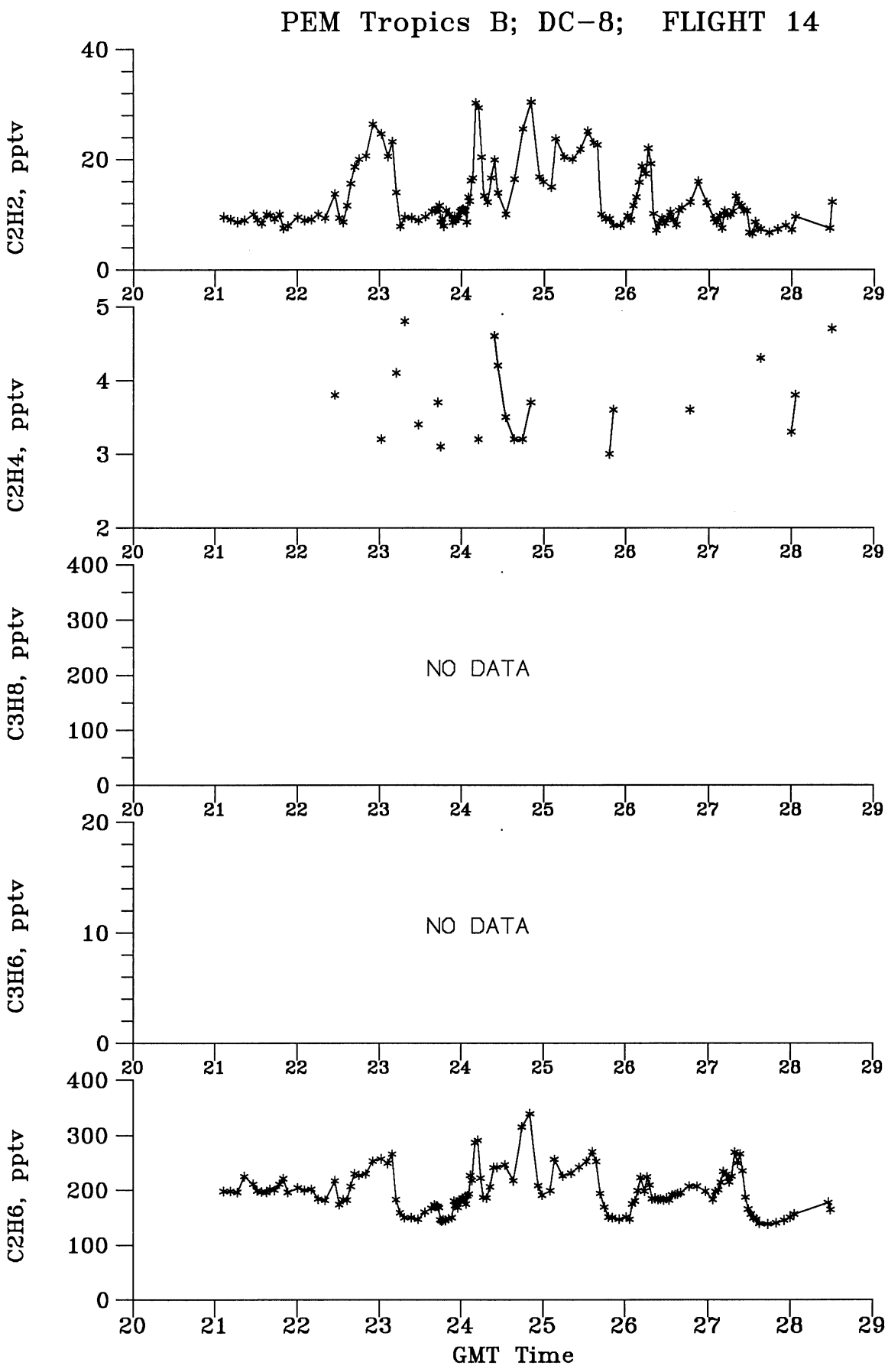
Southern Latitudes Characterization

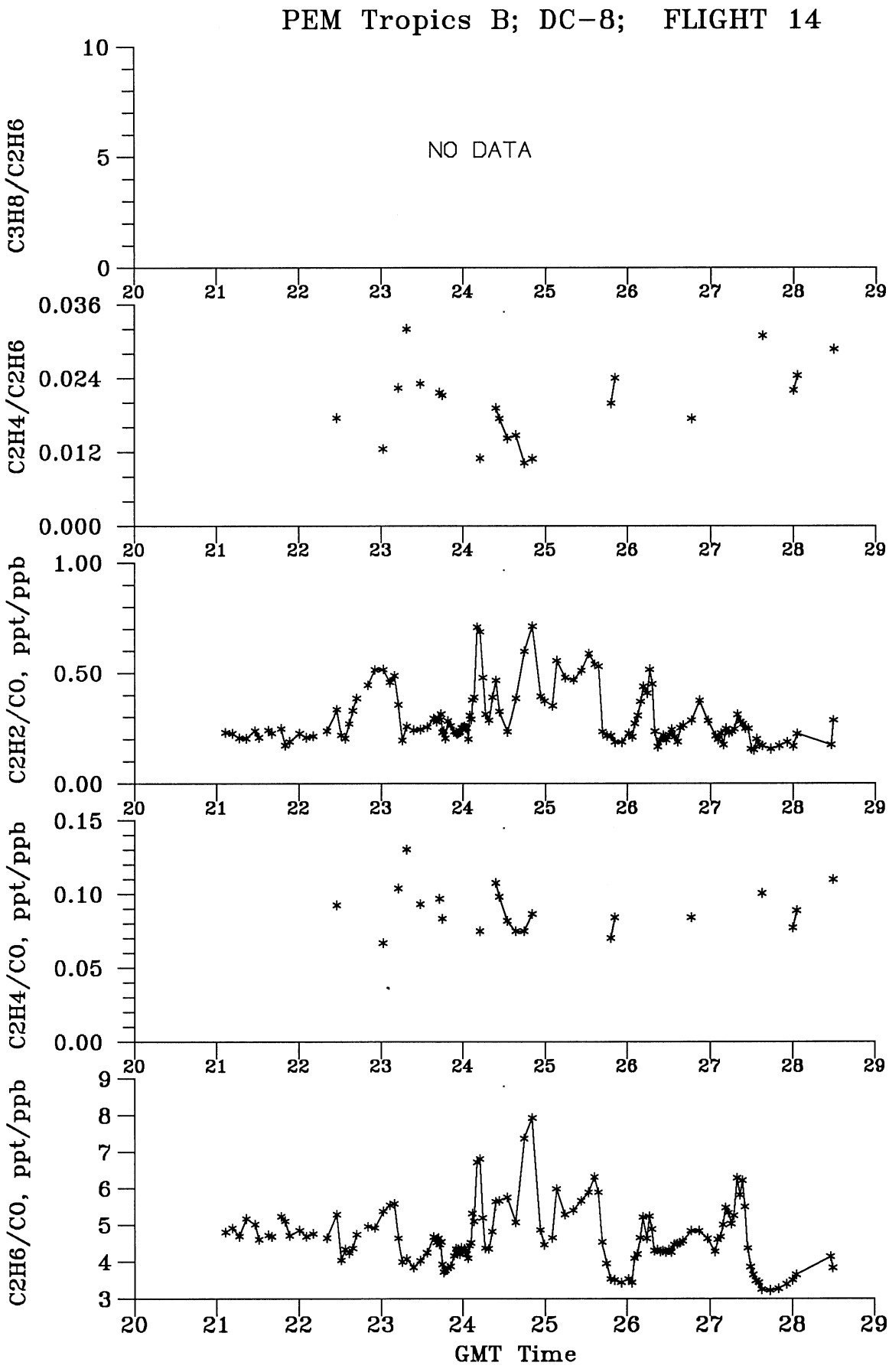
March 30, 1999

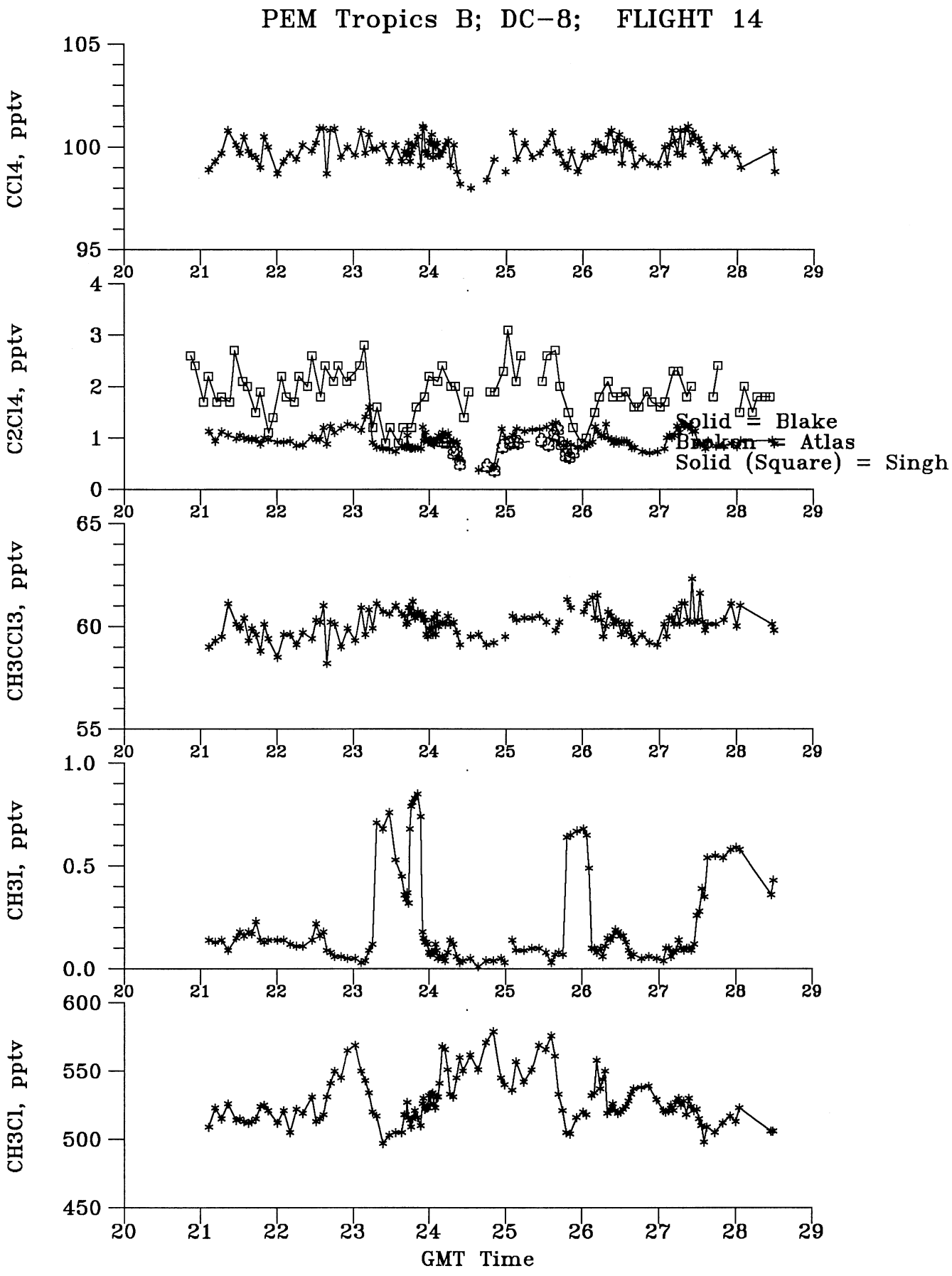

PEM Tropics B; DC-8; FLIGHT 14
North Latitude, deg.
-10
-20
-30
-40
210
215
220
225
230
East Longitude, deg.
Altitude, km
15
10
5
0
20
21
22
23
24
25
26
27
28
29
Temperature, C
40
20
0
-20
-40
-60
-80
Solid = Static Temp
Broken = Project Dew Pt.
Rel. Hum, percent
100
50
0
Water Vapor, ppmv
20000
10000
0
GMT Time

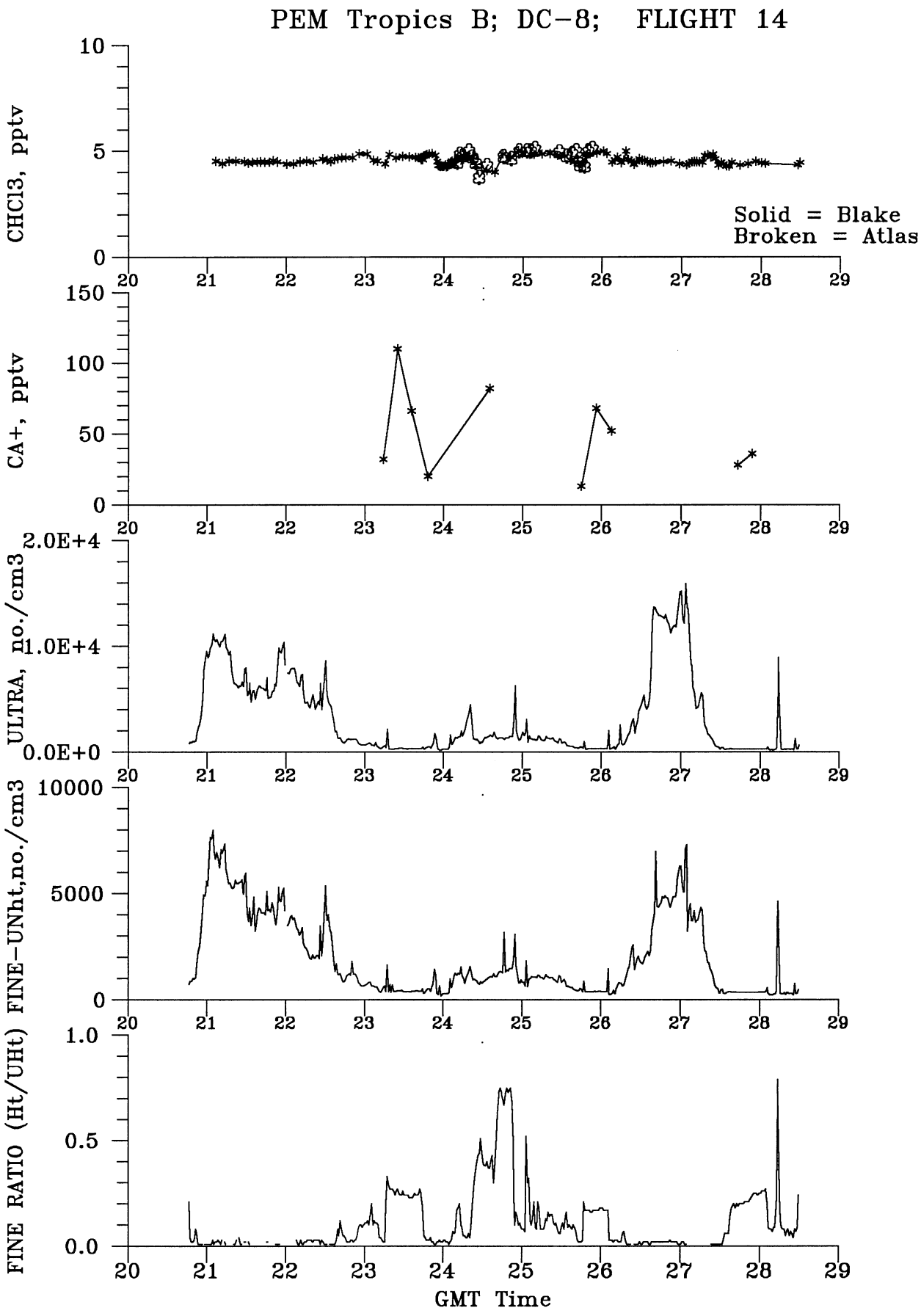

PEM Tropics B; DC-8; FLIGHT 14
O3, ppbv
120
100
80
60
40
20
0
CO, ppbv
60
50
40
30
CH4, ppbv
1800
1750
1700
1650
CO2, ppmv
370
365
360
OH, pptv
0.50
0.25
0.00
20
21
22
23
24
25
26
27
28
29
GMT Time

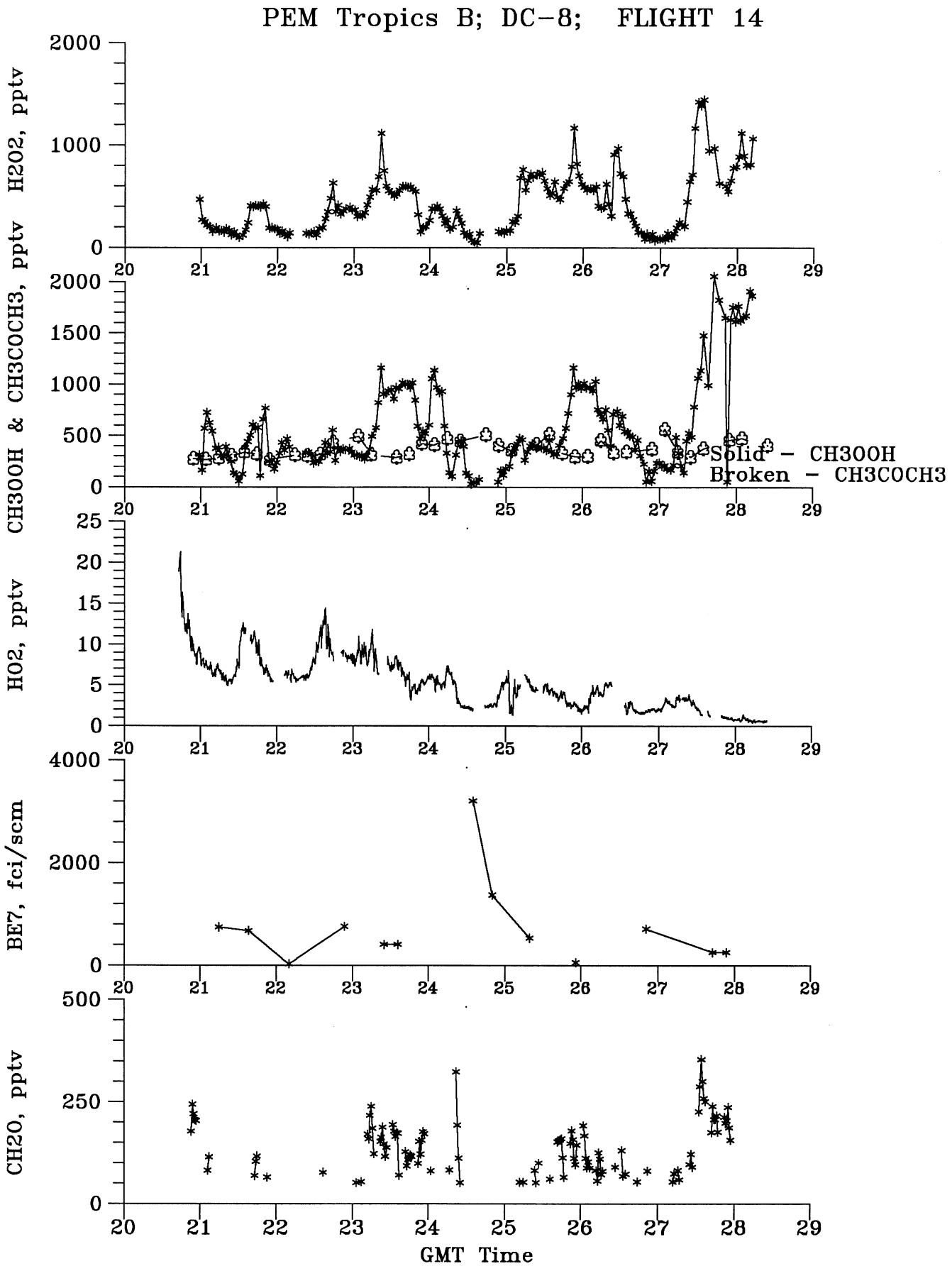

PEM Tropics B; DC-8; FLIGHT 14
NO, pptv
NO DATA
HNO3, pptv
NO2, pptv
SO2, pptv
DMS, pptv
GMT Time

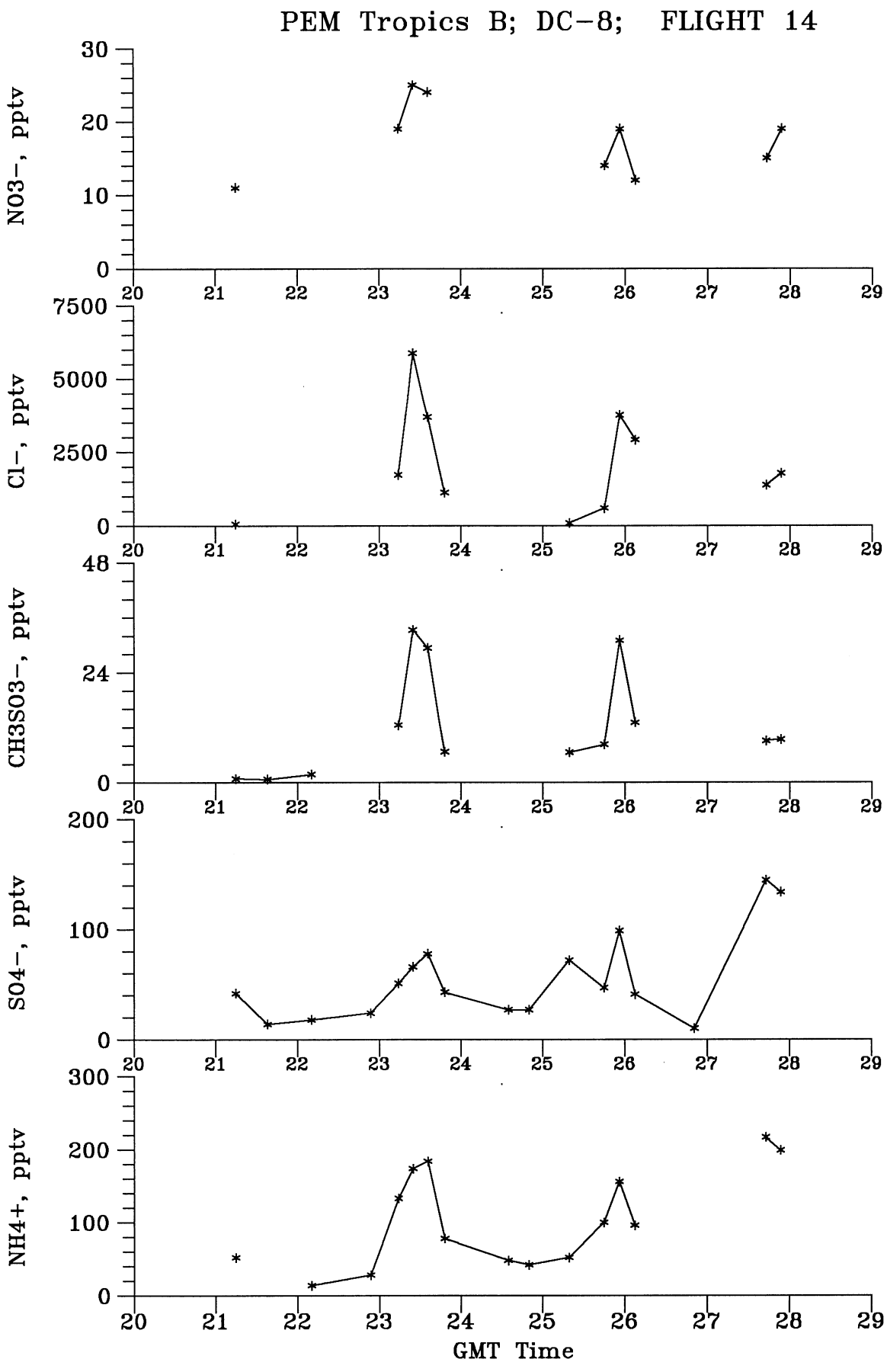

PEM Tropics B; DC-8; FLIGHT 14
C2H2, pptv
C2H4, pptv
C3H8, pptv
NO DATA
C3H6, pptv
NO DATA
C2H6, pptv
GMT Time

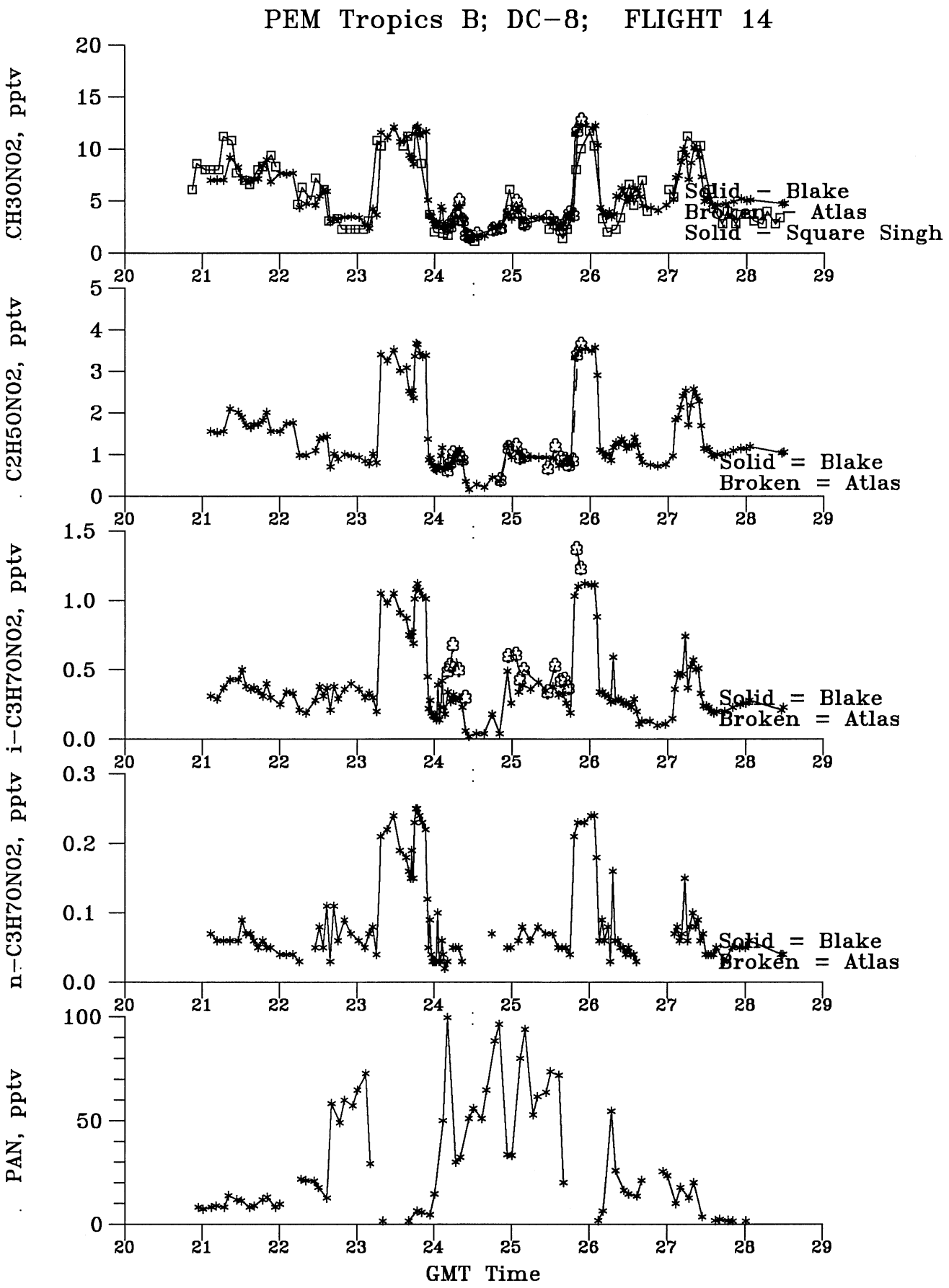

PEM Tropics B; DC-8; FLIGHT 14
C3H8/C2H6
NO DATA
C2H4/C2H6
C2H2/CO, ppt/ppb
C2H4/CO, ppt/ppb
C2H6/CO, ppt/ppb
GMT Time

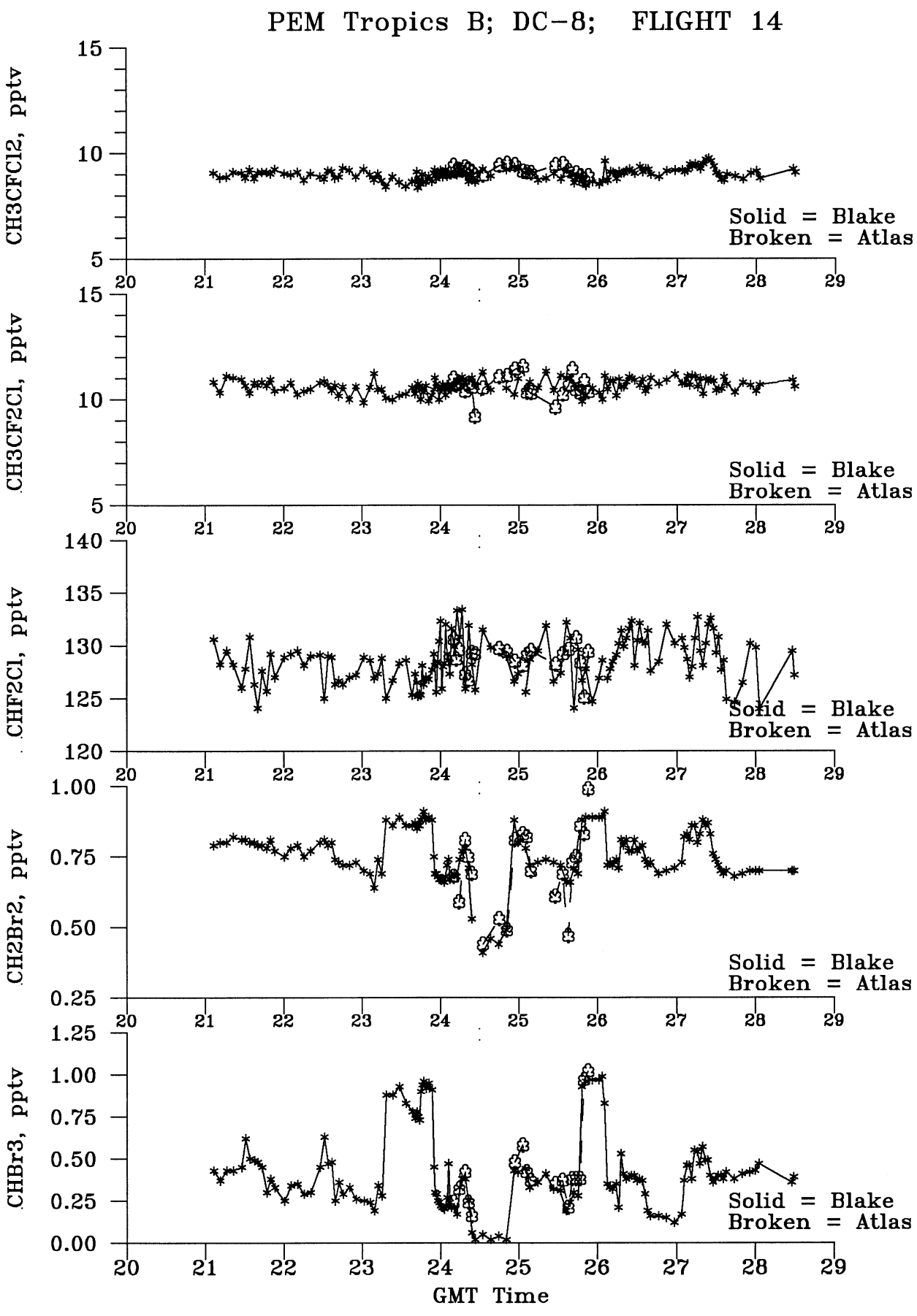

PEM Tropics B; DC-8; FLIGHT 14
CCl4, pptv
105
100
95
C2Cl4, pptv
4
3
2
1
0
Solid = Blake
Broken = Atlas
Solid (Square) = Singh
CH3CCl3, pptv
65
60
55
CH3I, pptv
1.0
0.5
0.0
CH3Cl, pptv
600
550
500
450
20
21
22
23
24
25
26
27
28
29
GMT Time

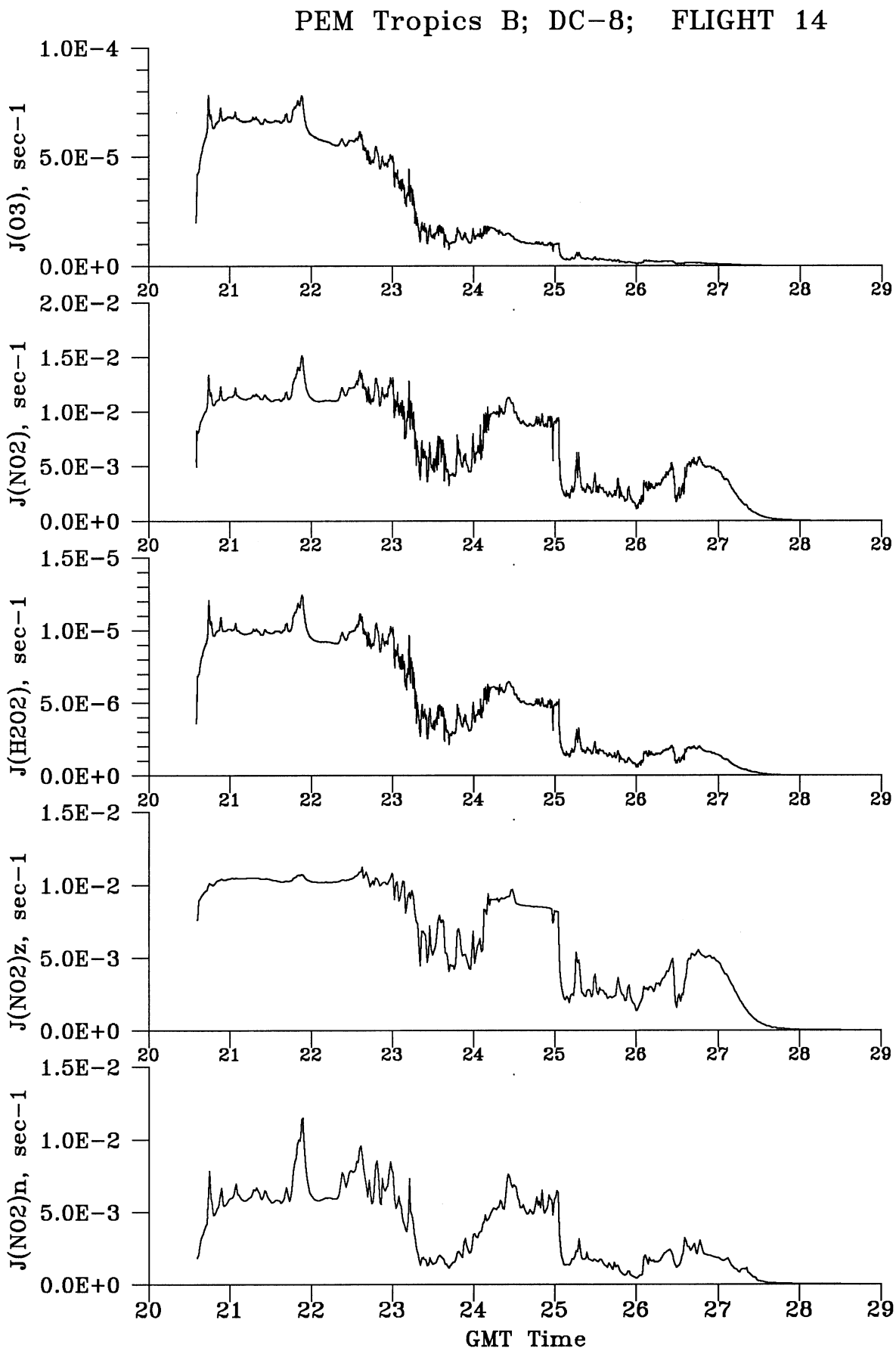

PEM Tropics B; DC-8; FLIGHT 14
CHCl3, pptv
Solid = Blake
Broken = Atlas
CA+, pptv
ULTRA, no./cm3
FINE-UNht,no./cm3
FINE RATIO (Ht/UHt)
GMT Time

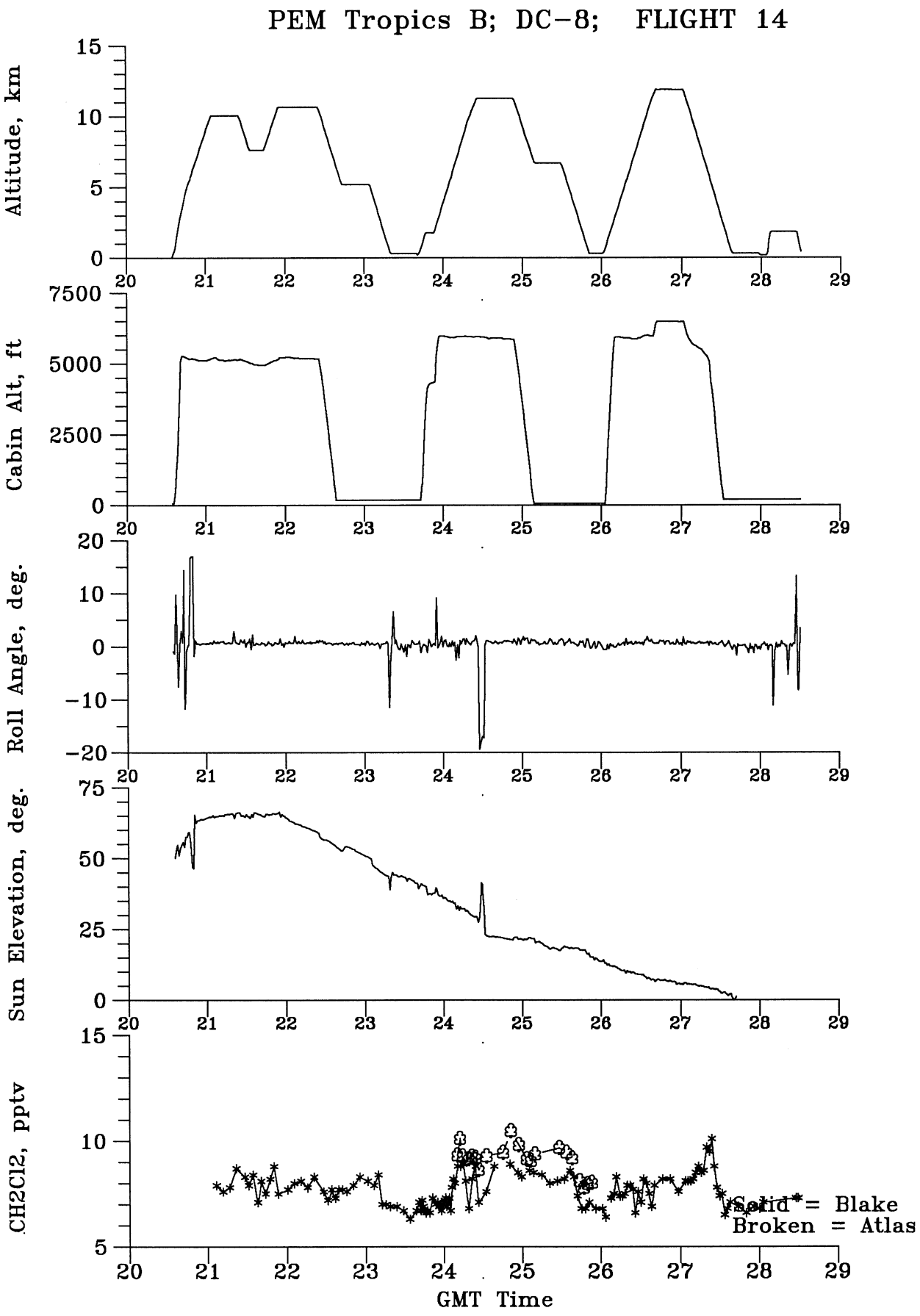

PEM Tropics B; DC-8; FLIGHT 14
H2O2, pptv
CH3OOH & CH3COCH3, pptv
Solid - CH3OOH
Broken - CH3COCH3
HO2, pptv
BE7, fci/scm
CH2O, pptv
GMT Time


PEM Tropics B; DC-8; FLIGHT 14
NO3-, pptv
30
20
10
0
Cl-, pptv
7500
5000
2500
0
CH3SO3-, pptv
48
24
0
SO4-, pptv
200
100
0
NH4+, pptv
300
200
100
0
20
21
22
23
24
25
26
27
28
29
GMT Time

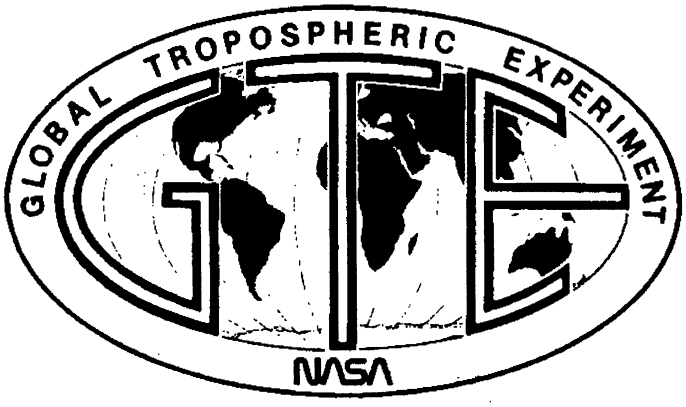

PEM Tropics B; DC-8; FLIGHT 14
CH3ONO2, pptv
Solid = Blake
Broken = Atlas
Solid = Square Singh
C2H5ONO2, pptv
Solid = Blake
Broken = Atlas
n-C3H7ONO2, pptv i-C3H7ONO2, pptv
Solid = Blake
Broken = Atlas
Solid = Blake
Broken = Atlas
PAN, pptv
GMT Time


PEM Tropics B; DC-8; FLIGHT 14
CH3CFCl2, pptv
15
10
5
Solid = Blake
Broken = Atlas
CH3CF2Cl, pptv
15
10
5
Solid = Blake
Broken = Atlas
CHF2Cl, pptv
140
135
130
125
120
Solid = Blake
Broken = Atlas
CH2Br2, pptv
1.00
0.75
0.50
0.25
Solid = Blake
Broken = Atlas
CHBr3, pptv
1.25
1.00
0.75
0.50
0.25
0.00
Solid = Blake
Broken = Atlas
20
21
22
23
24
25
26
27
28
29
GMT Time


PEM Tropics B; DC-8; FLIGHT 14
J(O3), sec-1
1.0E-4
5.0E-5
0.0E+0
J(NO2), sec-1
2.0E-2
1.5E-2
1.0E-2
5.0E-3
0.0E+0
J(H2O2), sec-1
1.5E-5
1.0E-5
5.0E-6
0.0E+0
J(NO2)z, sec-1
1.5E-2
1.0E-2
5.0E-3
0.0E+0
J(NO2)n, sec-1
1.5E-2
1.0E-2
5.0E-3
0.0E+0
20
21
22
23
24
25
26
27
28
29
GMT Time


PEM Tropics B; DC-8; FLIGHT 14
Altitude, km
Cabin Alt, ft
Roll Angle, deg.
Sun Elevation, deg.
CH2Cl2, pptv
Solid = Blake
Broken = Atlas
GMT Time

PLOTS OF FINAL CHEMICAL DATA



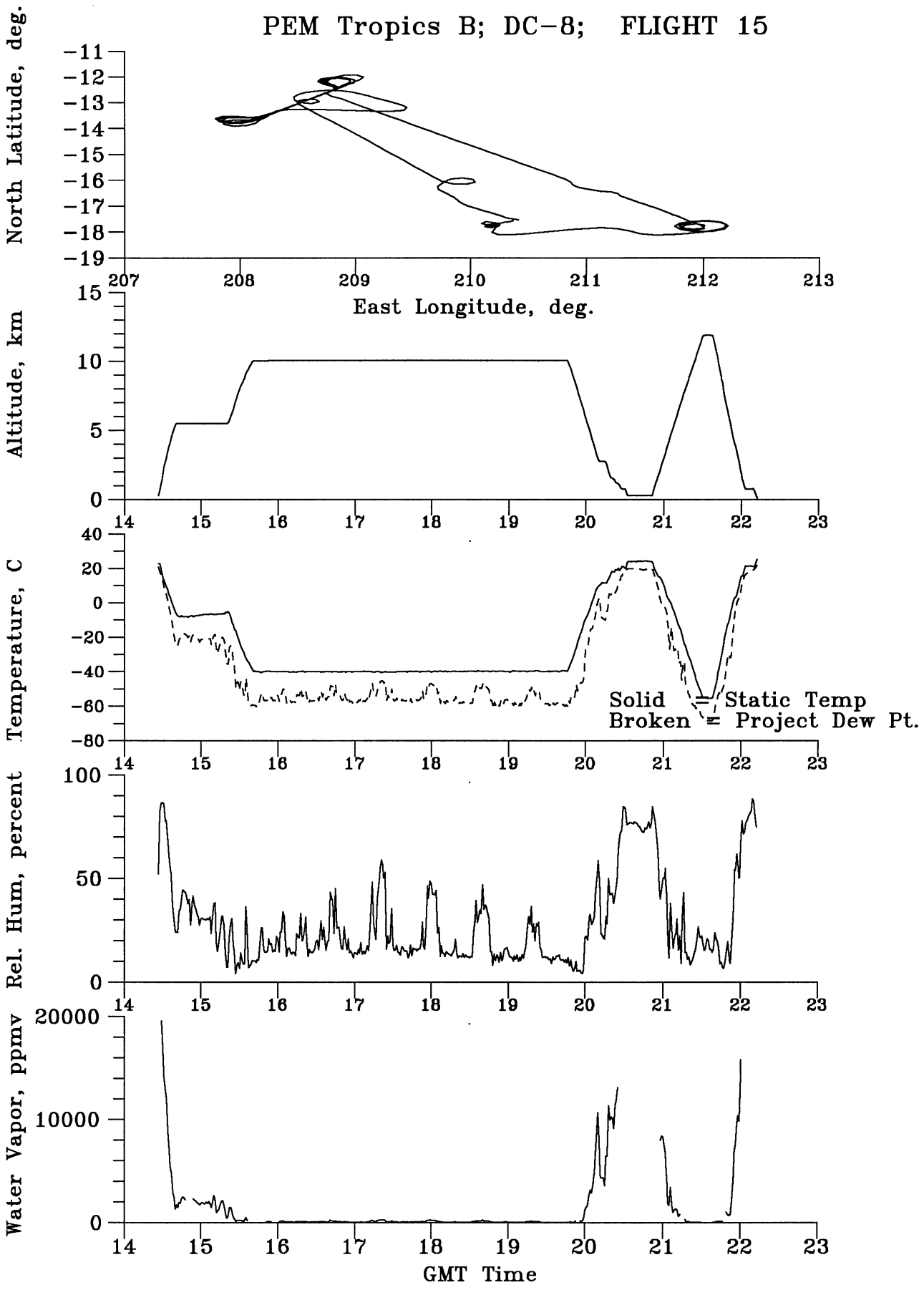
PEM-TROPICS B

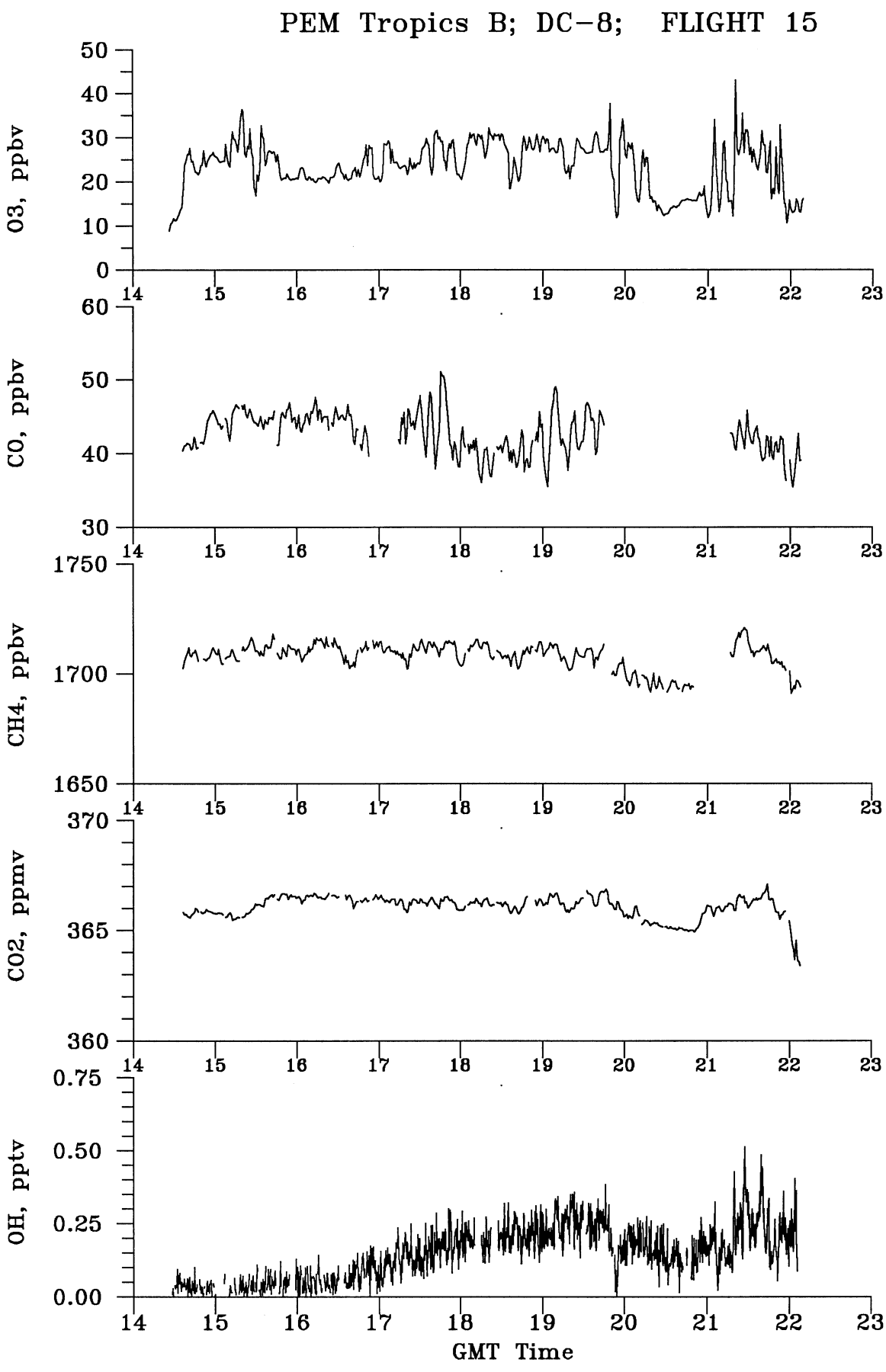
Flight 15D

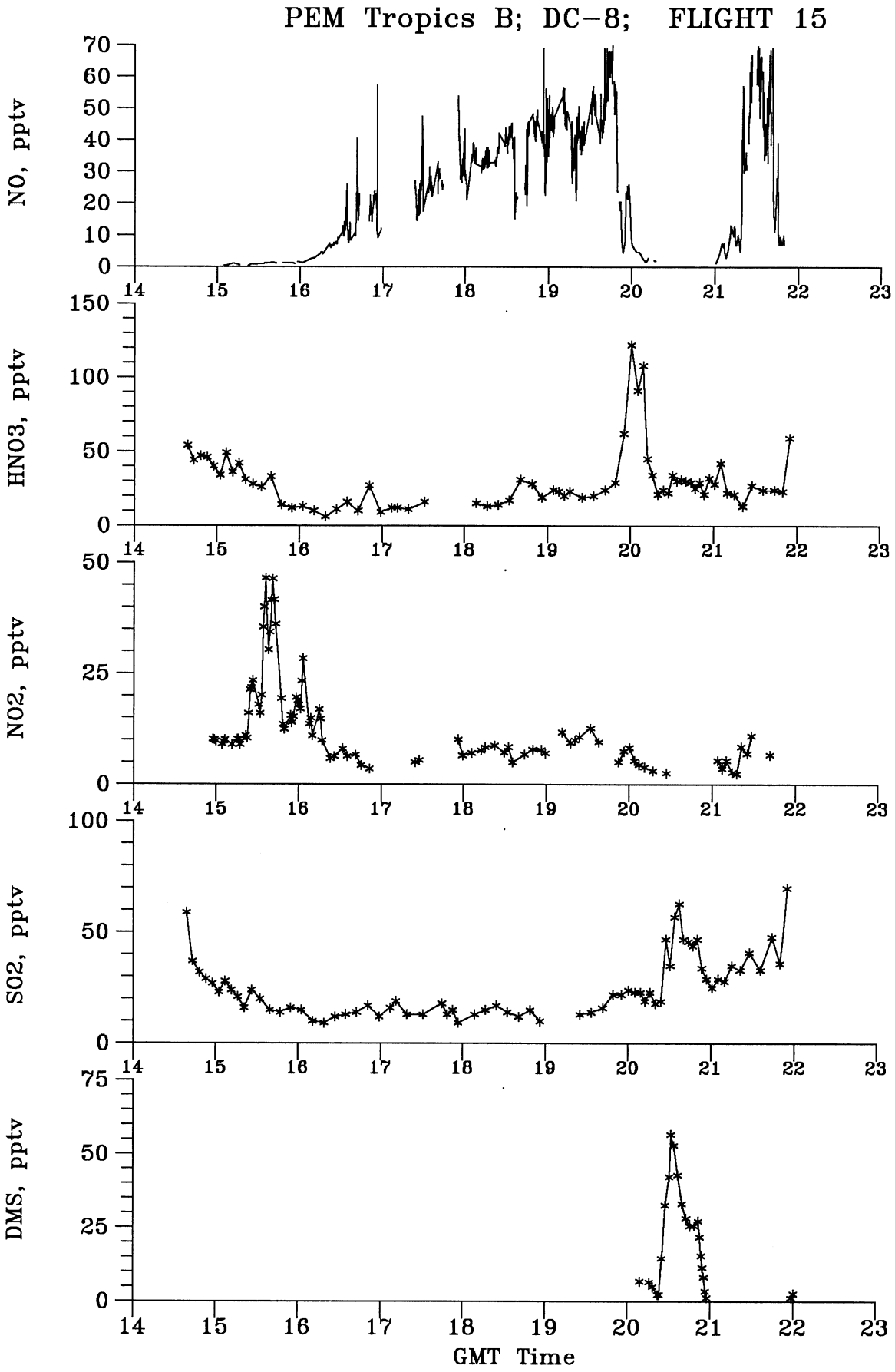
Local: Tahiti No. 2

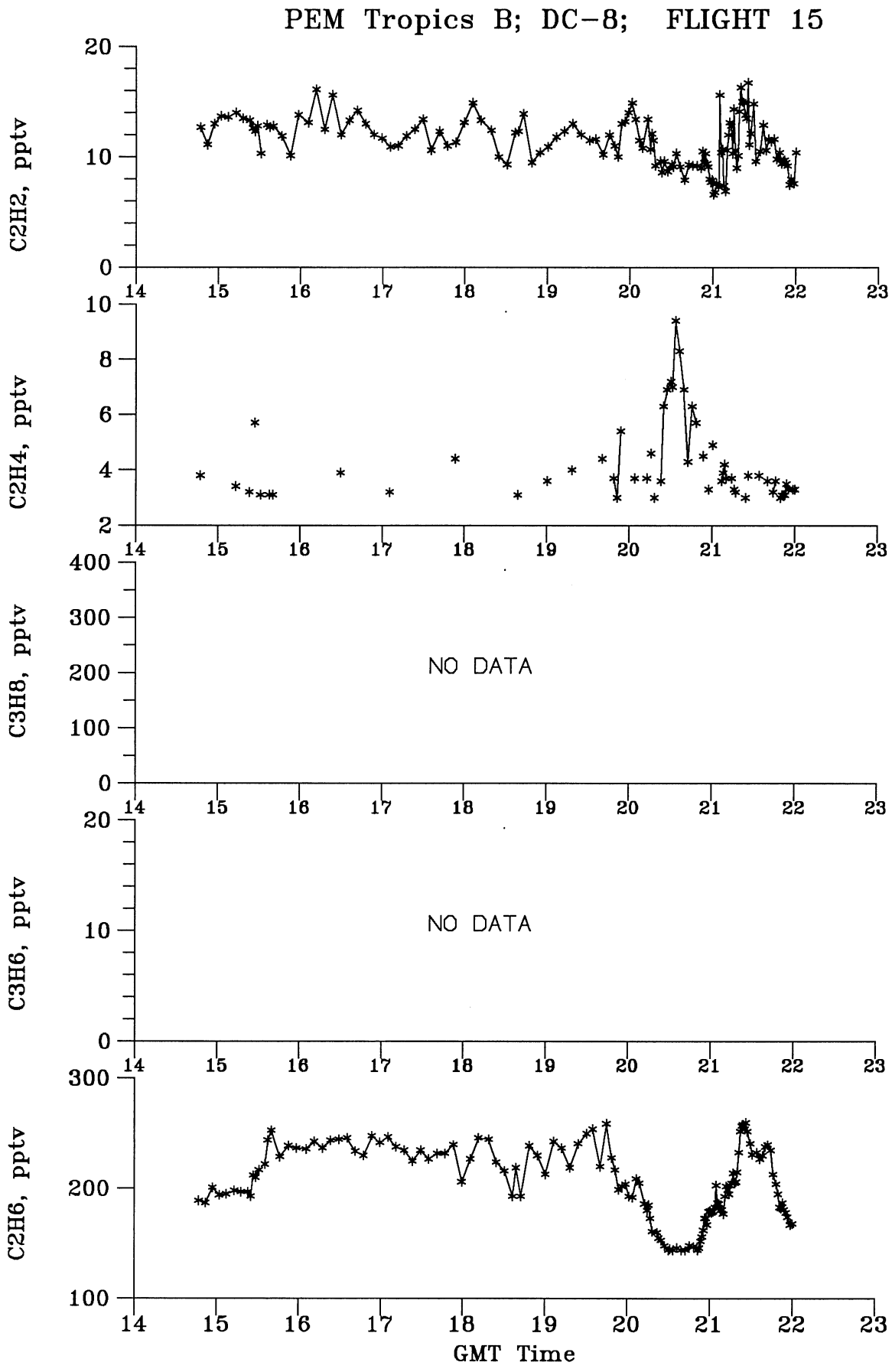
Sunrise HO_x/NO_x Chemistry

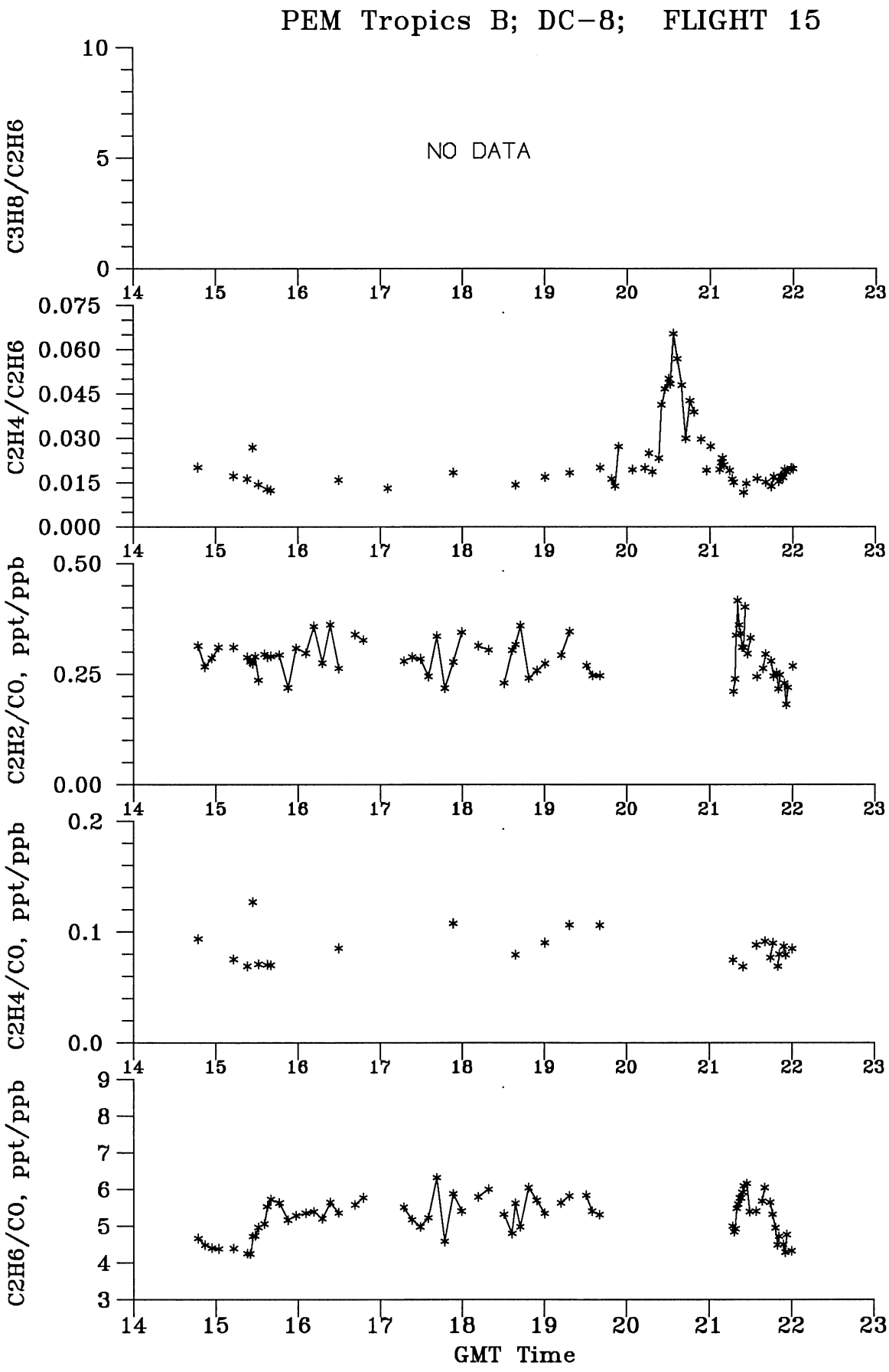
April 2, 1999

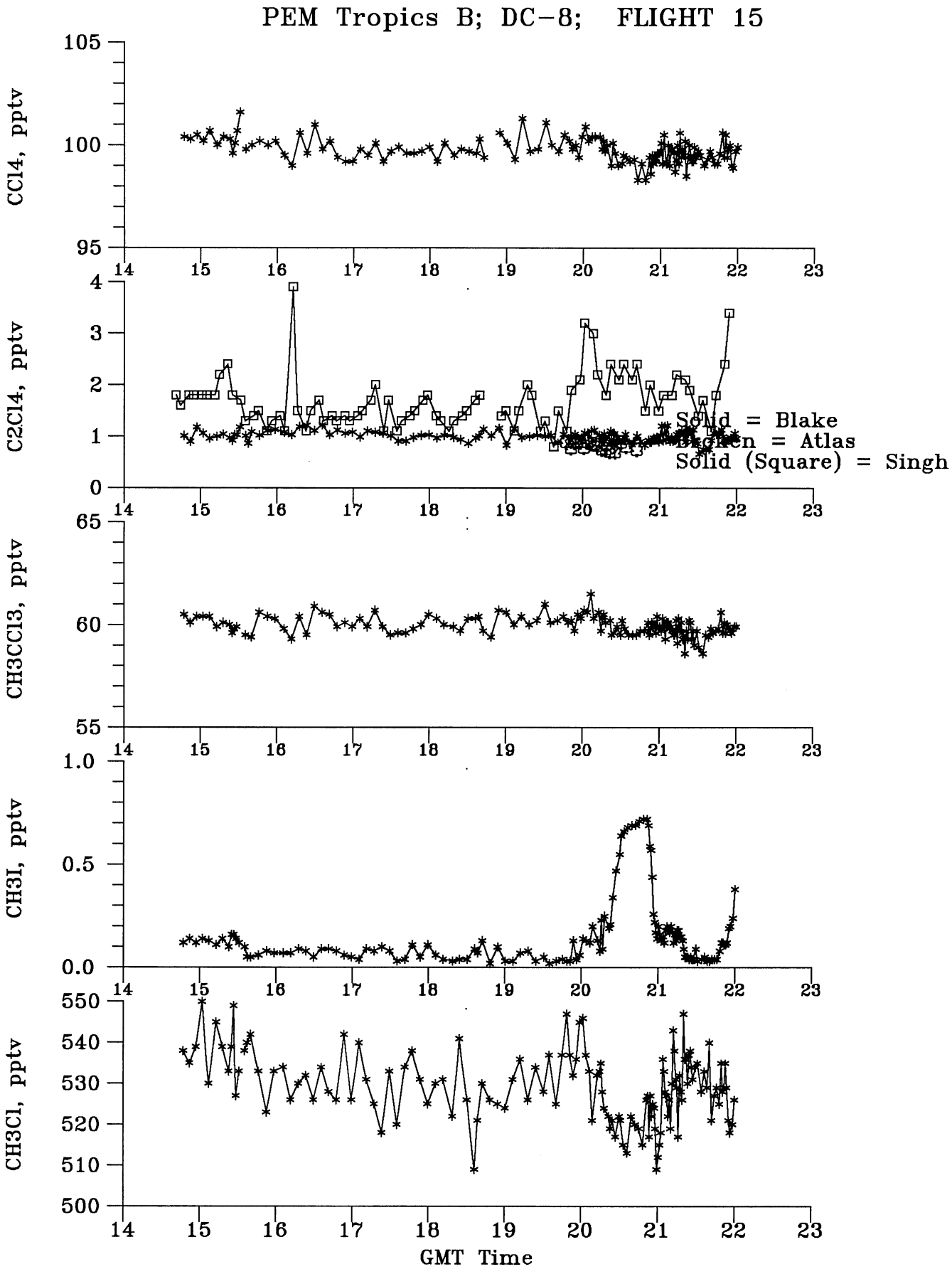

PEM Tropics B; DC-8; FLIGHT 15
North Latitude, deg.
-11
-12
-13
-14
-15
-16
-17
-18
-19
207
208
209
210
211
212
213
East Longitude, deg.
Altitude, km
15
10
5
0
14
15
16
17
18
19
20
21
22
23
Temperature, C
40
20
0
-20
-40
-60
-80
Solid = Static Temp
Broken = Project Dew Pt.
Rel. Hum, percent
100
50
0
Water Vapor, ppmv
20000
10000
0
GMT Time

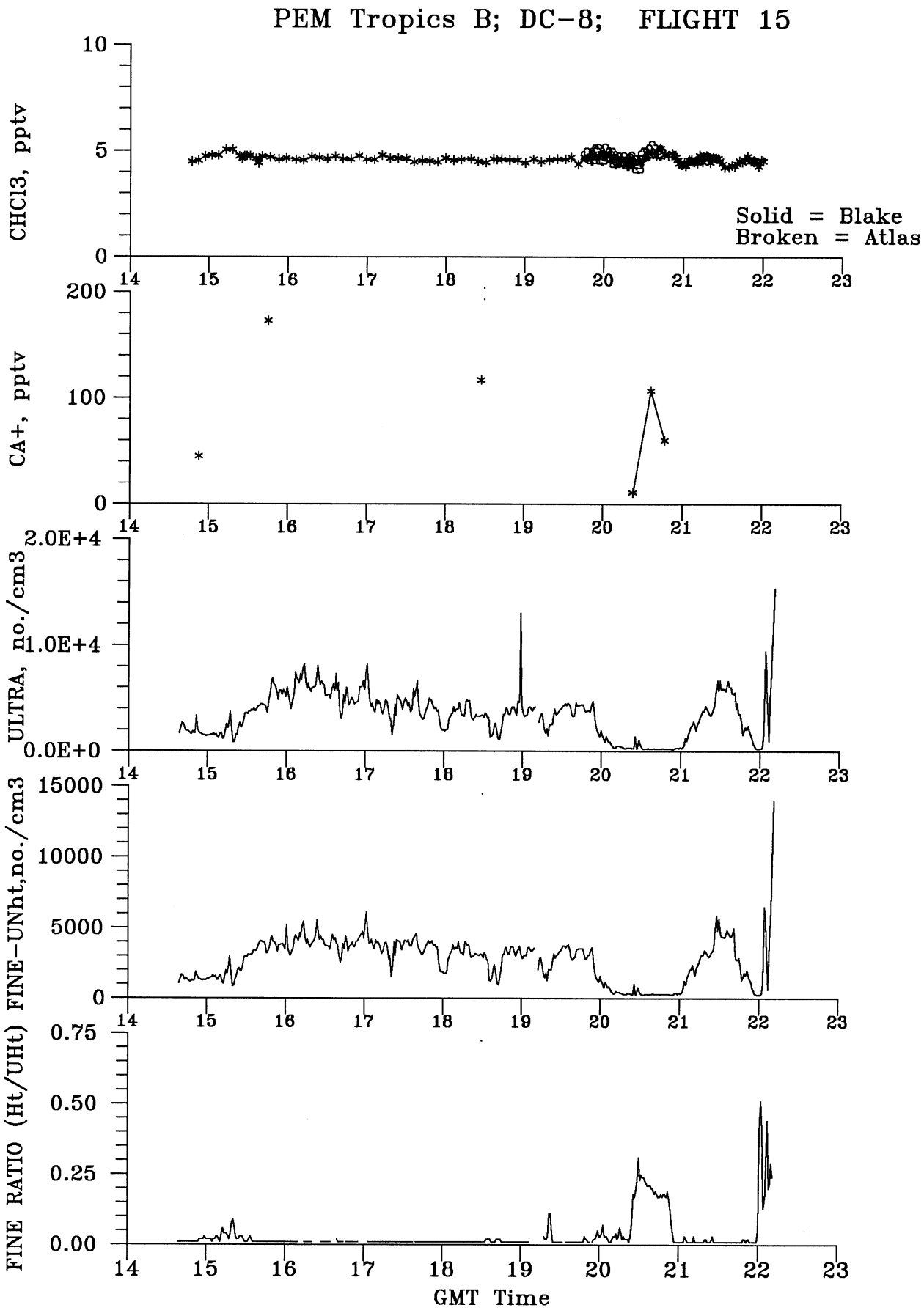

PEM Tropics B; DC-8; FLIGHT 15
O3, ppbv
50
40
30
20
10
0
CO, ppbv
60
50
40
30
CH4, ppbv
1750
1700
1650
CO2, ppmv
370
365
360
OH, pptv
0.75
0.50
0.25
0.00
14
15
16
17
18
19
20
21
22
23
GMT Time

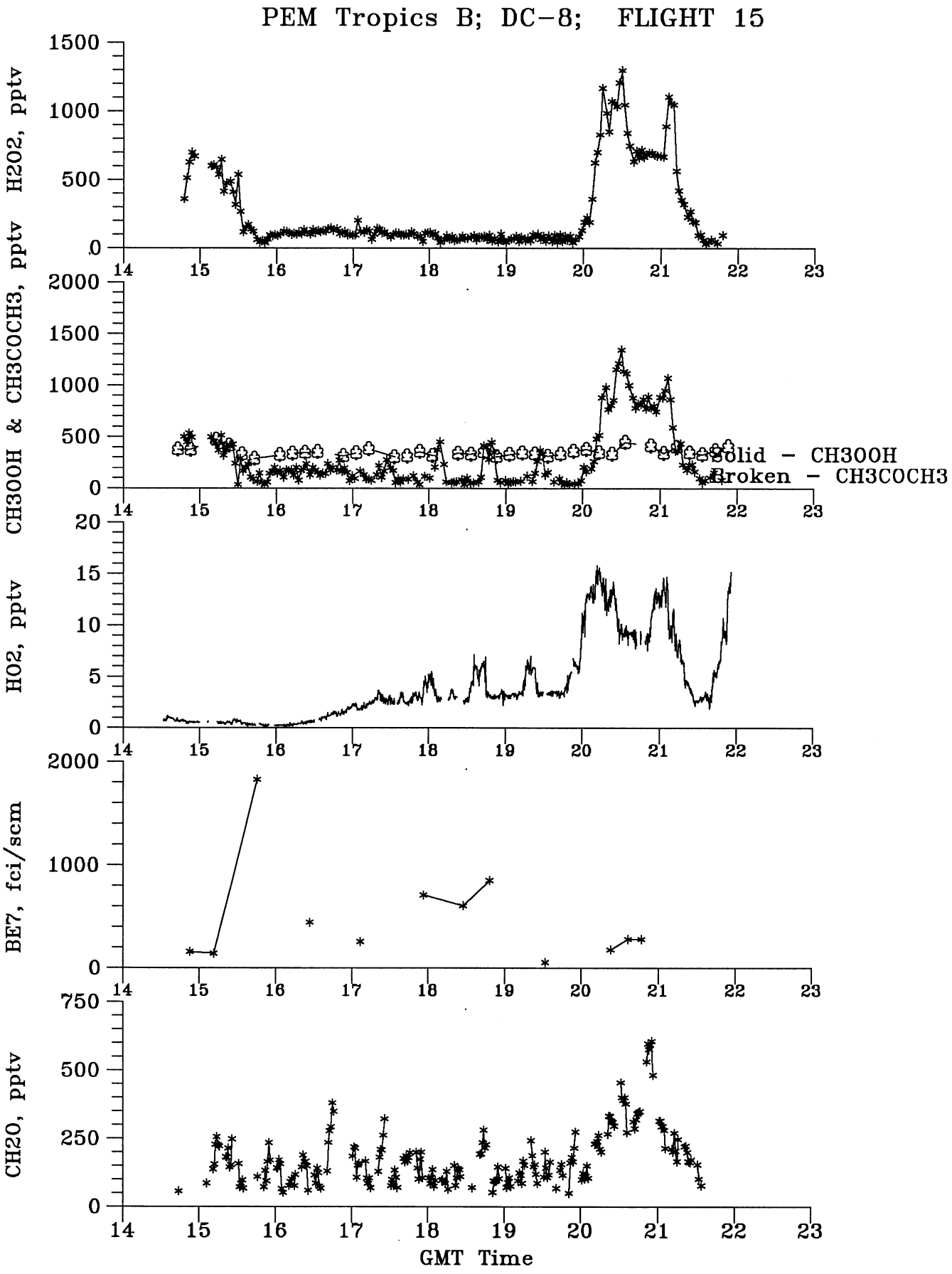

PEM Tropics B; DC-8; FLIGHT 15
NO, pptv
70
60
50
40
30
20
10
0
HNO3, pptv
150
100
50
0
NO2, pptv
50
25
0
SO2, pptv
100
50
0
DMS, pptv
75
50
25
0
14
15
16
17
18
19
20
21
22
23
GMT Time

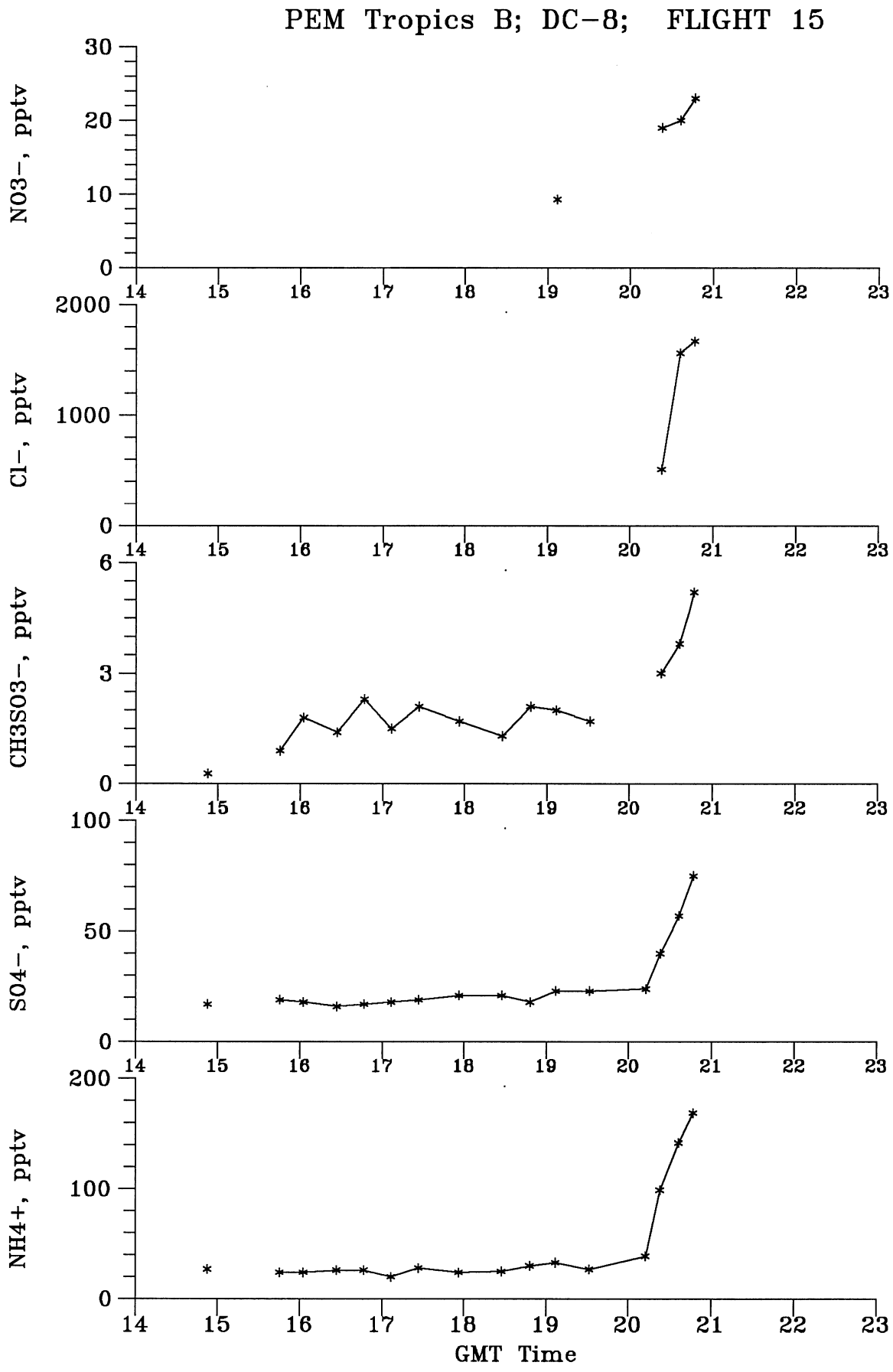

PEM Tropics B; DC-8; FLIGHT 15
C2H2, pptv
20
10
0
C2H4, pptv
10
8
6
4
2
C3H8, pptv
400
300
200
100
0
NO DATA
C3H6, pptv
20
10
0
NO DATA
C2H6, pptv
300
200
100
14
15
16
17
18
19
20
21
22
23
GMT Time

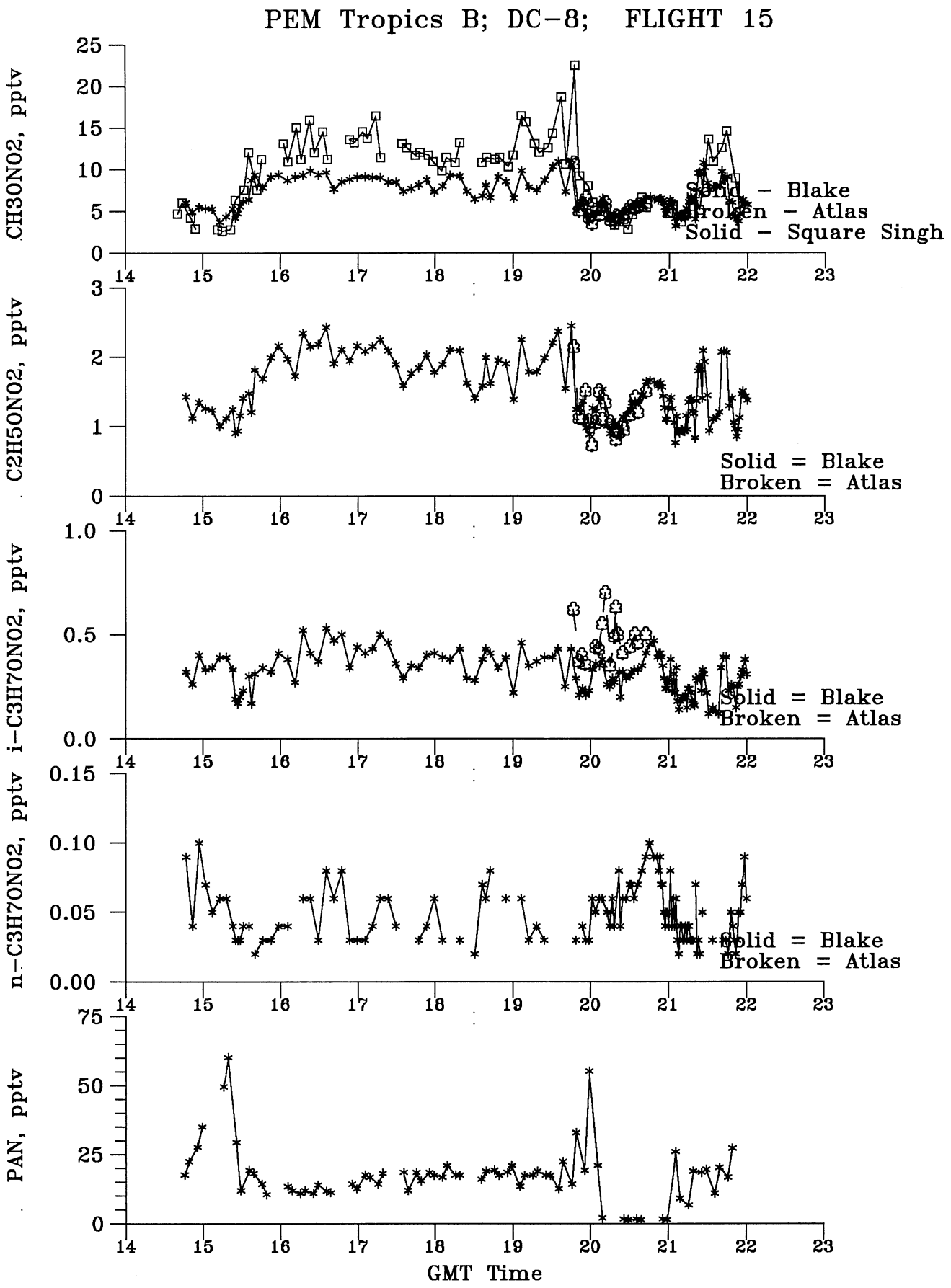

PEM Tropics B; DC-8; FLIGHT 15
C3H8/C2H6
NO DATA
C2H4/C2H6
C2H2/CO, ppt/ppb
C2H4/CO, ppt/ppb
C2H6/CO, ppt/ppb
GMT Time

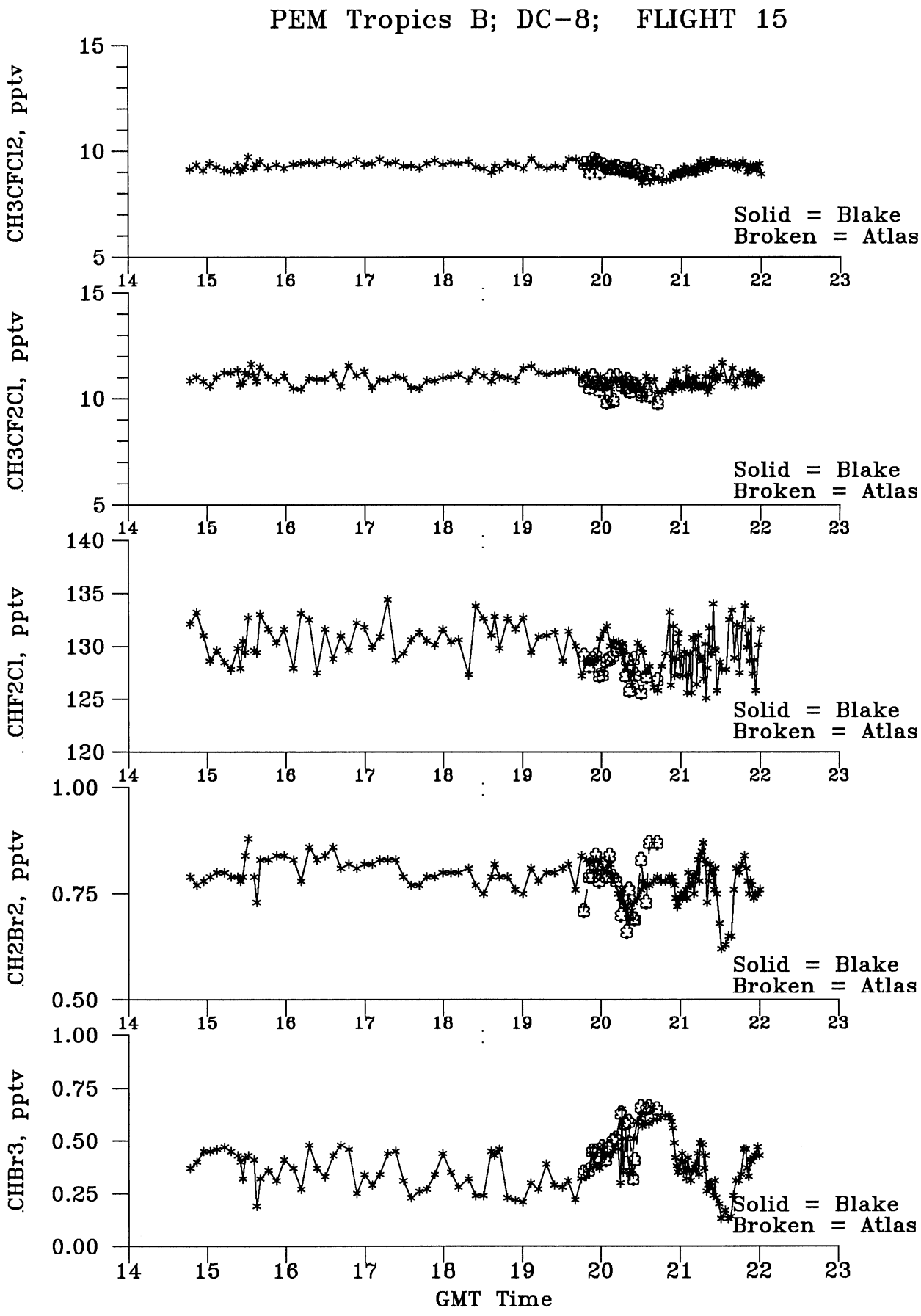

PEM Tropics B; DC-8; FLIGHT 15
CCl4, pptv
105
100
95
C2Cl4, pptv
4
3
2
1
0
Solid = Blake
Solid (Square) = Singh
CH3CCl3, pptv
65
60
55
CH3I, pptv
1.0
0.5
0.0
CH3Cl, pptv
550
540
530
520
510
500
14
15
16
17
18
19
20
21
22
23
GMT Time

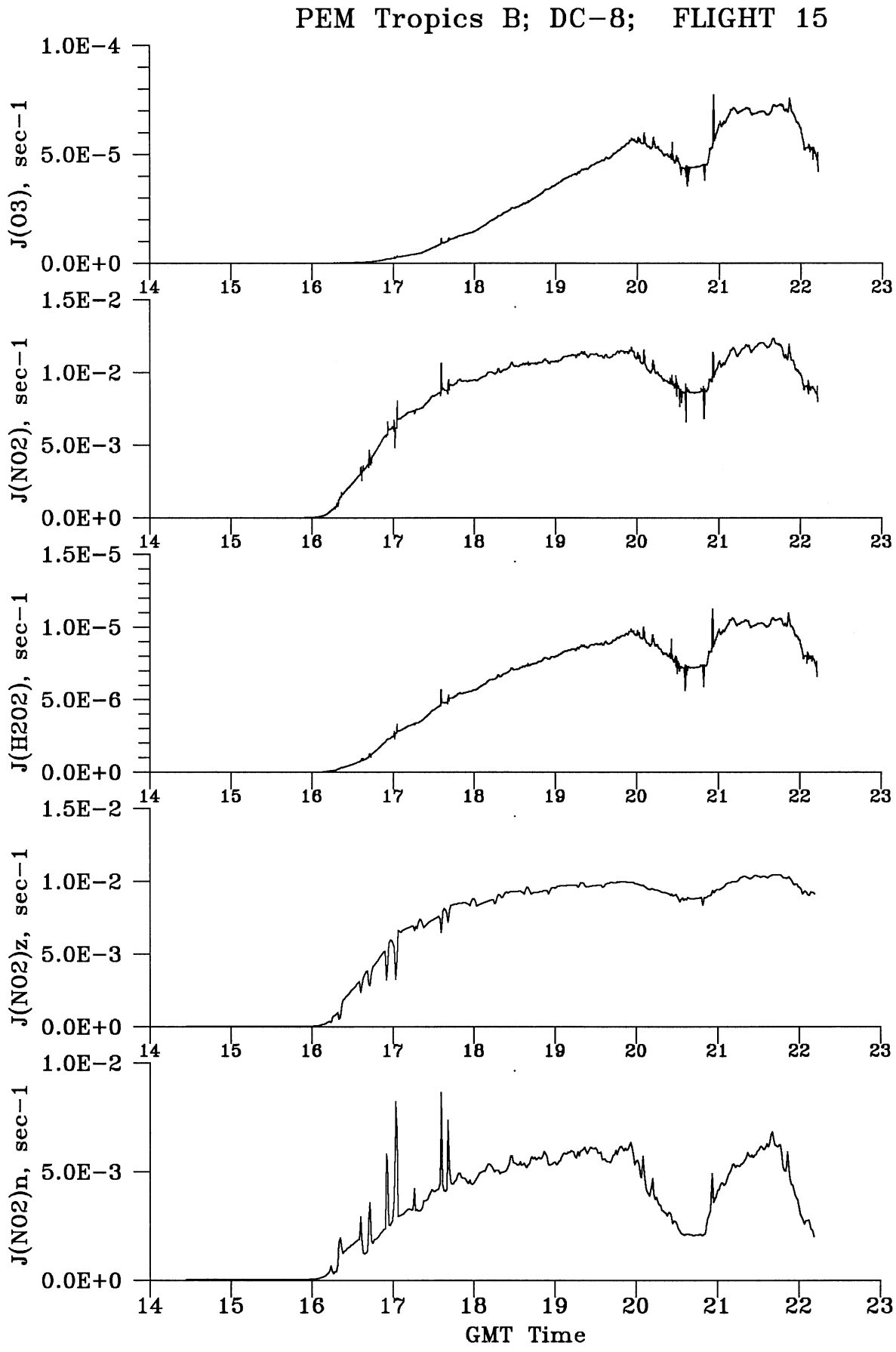

PEM Tropics B; DC-8; FLIGHT 15
CHCl3, pptv
Solid = Blake
Broken = Atlas
CA+, pptv
ULTRA, no./cm3
FINE-UNht,no./cm3
FINE RATIO (Ht/UHt)
GMT Time

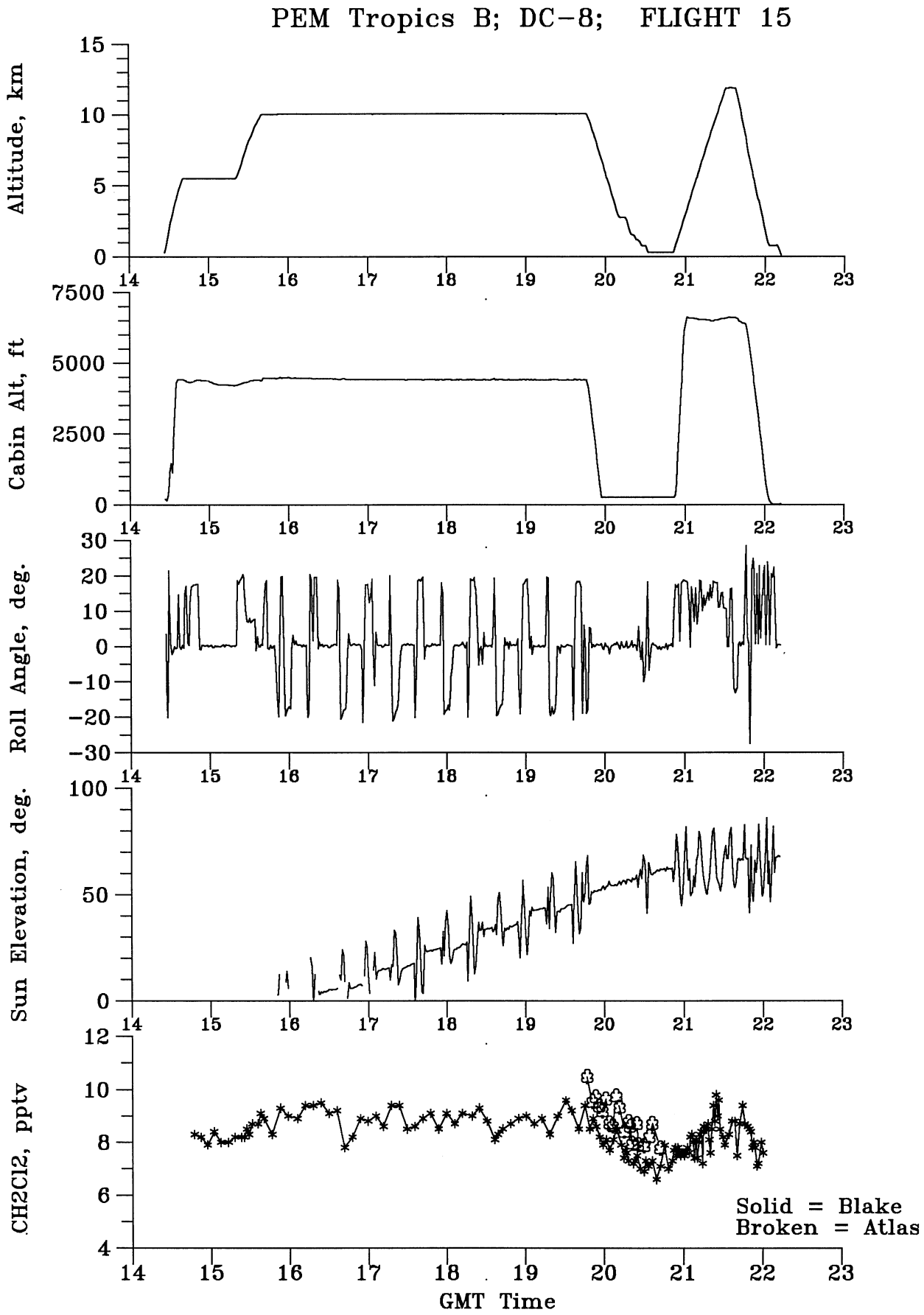

PEM Tropics B; DC-8; FLIGHT 15
H2O2, pptv
CH3OOH & CH3COCH3, pptv
Solid - CH3OOH
Broken - CH3COCH3
HO2, pptv
BE7, fci/scm
CH2O, pptv
GMT Time


PEM Tropics B; DC-8; FLIGHT 15
NO3-, pptv
30
20
10
0
Cl-, pptv
2000
1000
0
CH3SO3-, pptv
6
3
0
SO4-, pptv
100
50
0
NH4+, pptv
200
100
0
14
15
16
17
18
19
20
21
22
23
GMT Time

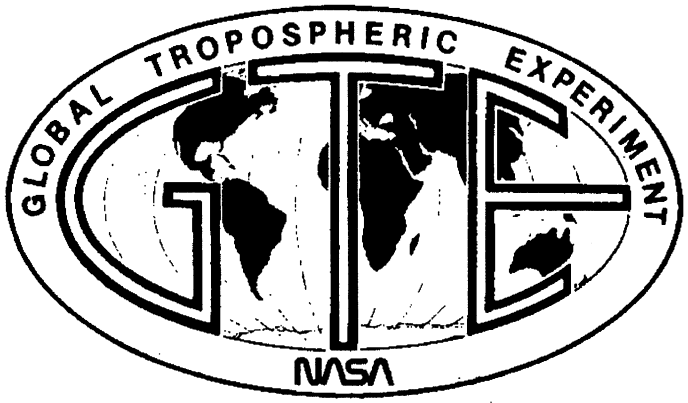

PEM Tropics B; DC-8; FLIGHT 15
CH3ONO2, pptv
Solid - Blake
Broken - Atlas
Solid - Square Singh
C2H5ONO2, pptv
Solid = Blake
Broken = Atlas
i-C3H7ONO2, pptv
Solid = Blake
Broken = Atlas
n-C3H7ONO2, pptv
Solid = Blake
Broken = Atlas
PAN, pptv
GMT Time


PEM Tropics B; DC-8; FLIGHT 15
CH3CFCl2, pptv
15
10
5
Solid = Blake
Broken = Atlas
CH3CF2Cl, pptv
15
10
5
Solid = Blake
Broken = Atlas
CHF2Cl, pptv
140
135
130
125
120
Solid = Blake
Broken = Atlas
CH2Br2, pptv
1.00
0.75
0.50
Solid = Blake
Broken = Atlas
CHBr3, pptv
1.00
0.75
0.50
0.25
0.00
Solid = Blake
Broken = Atlas
14 15 16 17 18 19 20 21 22 23
GMT Time


PEM Tropics B; DC-8; FLIGHT 15
J(O3), sec-1
1.0E-4
5.0E-5
0.0E+0
J(NO2), sec-1
1.5E-2
1.0E-2
5.0E-3
0.0E+0
J(H2O2), sec-1
1.5E-5
1.0E-5
5.0E-6
0.0E+0
J(NO2)z, sec-1
1.5E-2
1.0E-2
5.0E-3
0.0E+0
J(NO2)n, sec-1
1.0E-2
5.0E-3
0.0E+0
14 15 16 17 18 19 20 21 22 23
GMT Time


PEM Tropics B; DC-8; FLIGHT 15
Altitude, km
15
10
5
0
Cabin Alt, ft
7500
5000
2500
0
Roll Angle, deg.
30
20
10
0
−10
−20
−30
Sun Elevation, deg.
100
50
0
CH2Cl2, pptv
12
10
8
6
4
14
15
16
17
18
19
20
21
22
23
GMT Time
Solid = Blake
Broken = Atlas

PLOTS OF FINAL CHEMICAL DATA



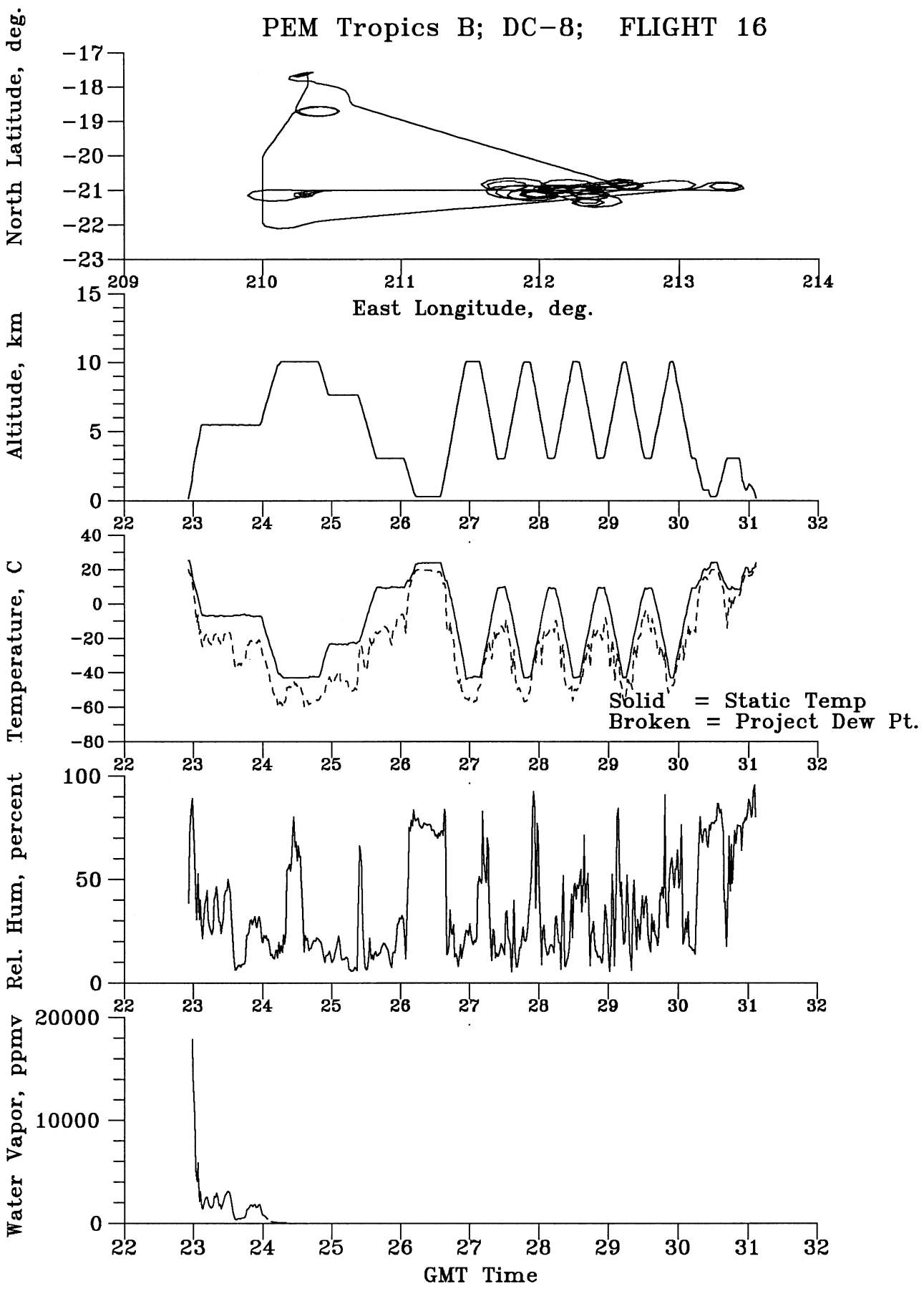
PEM-TROPICS B

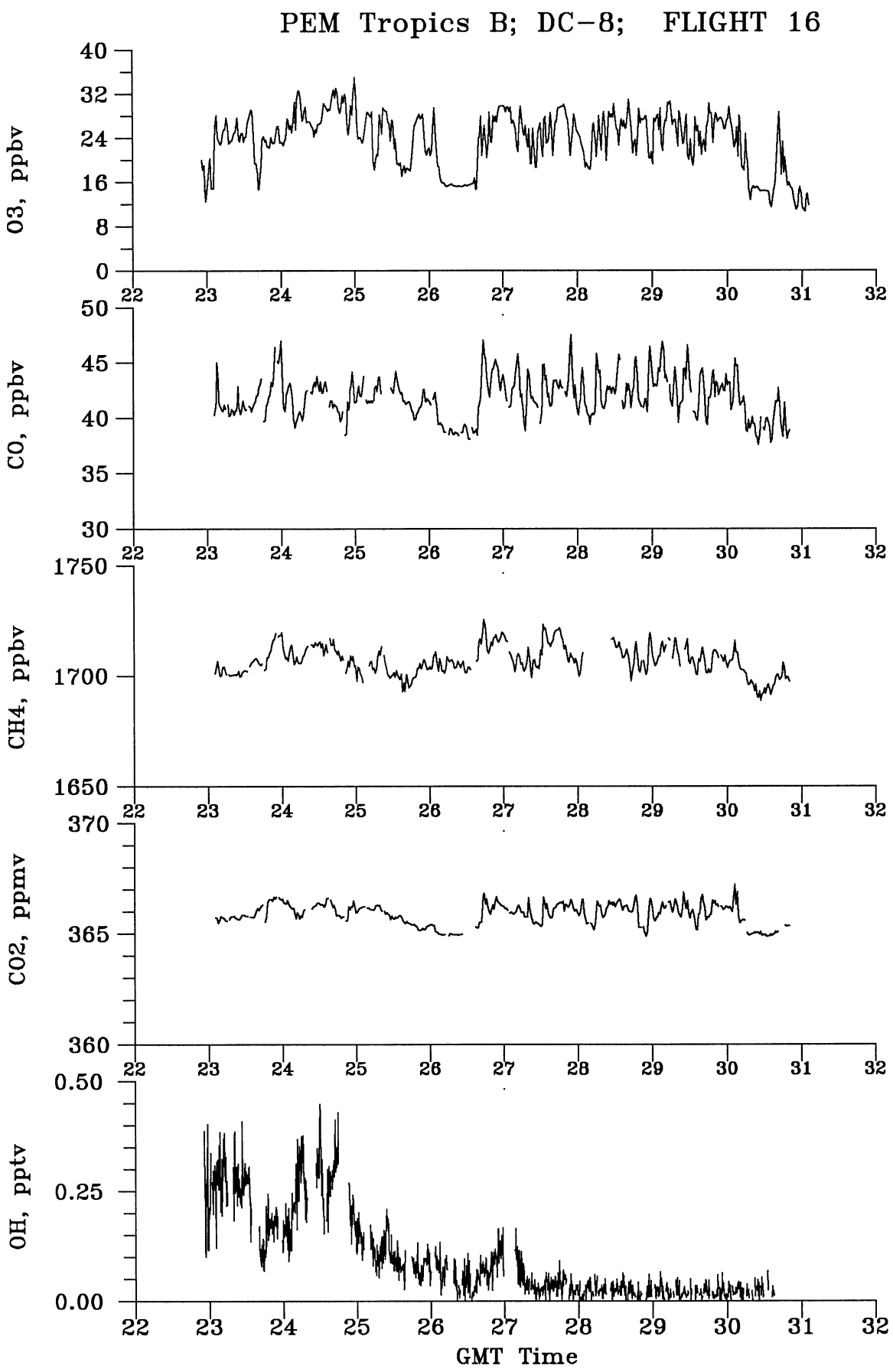
Flight 16D

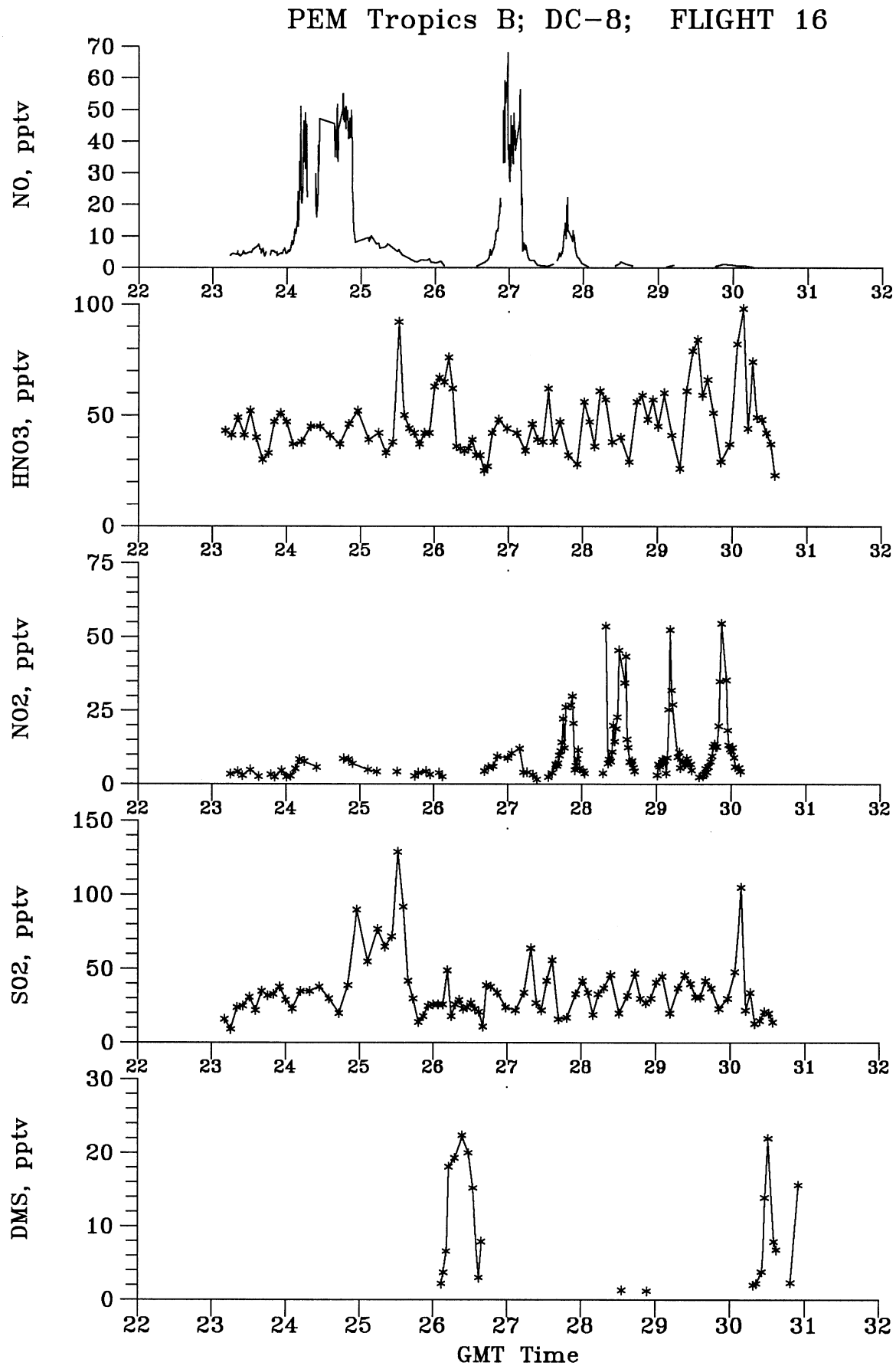
Local: Tahiti No. 3

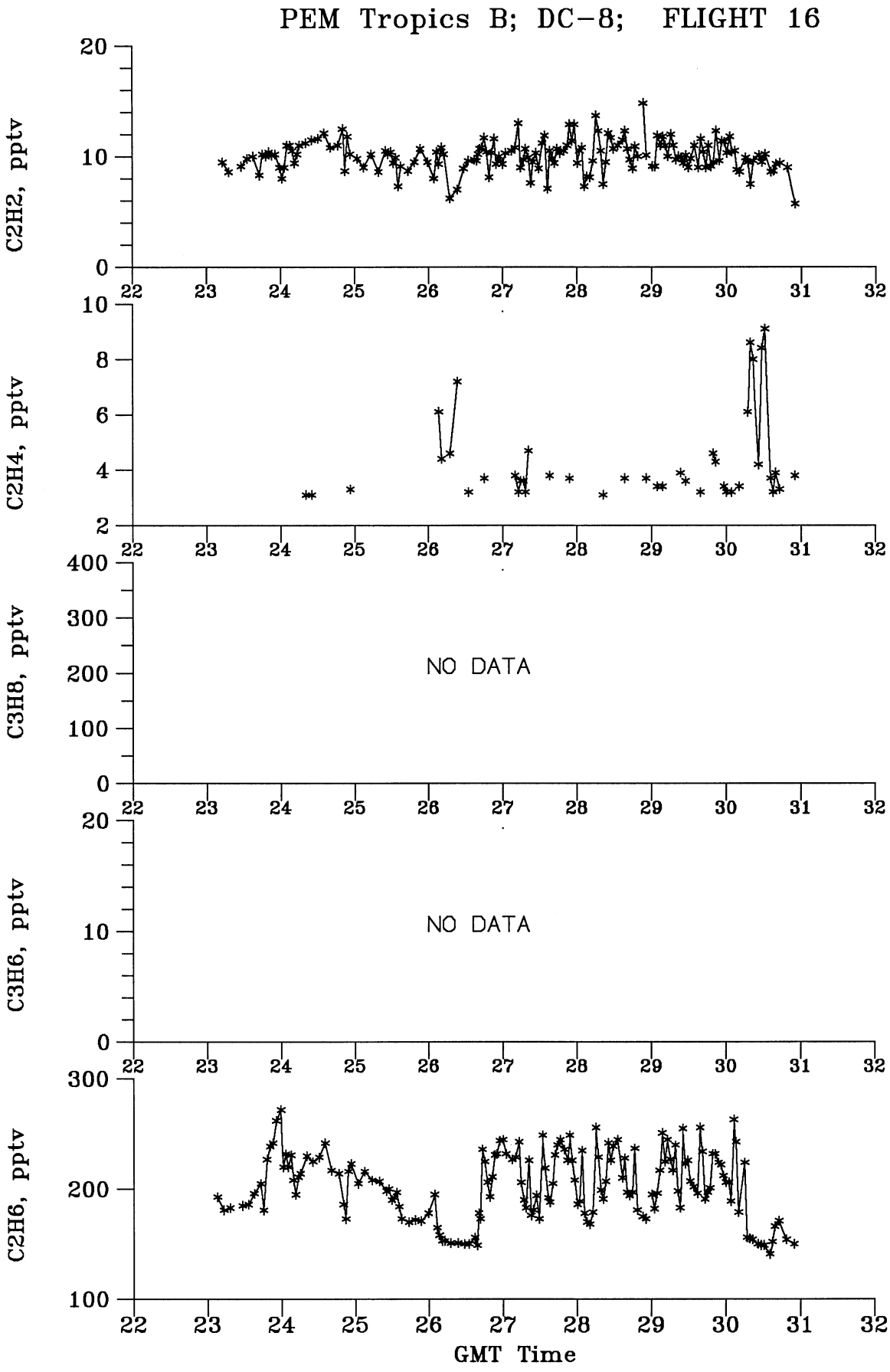
Sunset HO_x/NO_x Chemistry

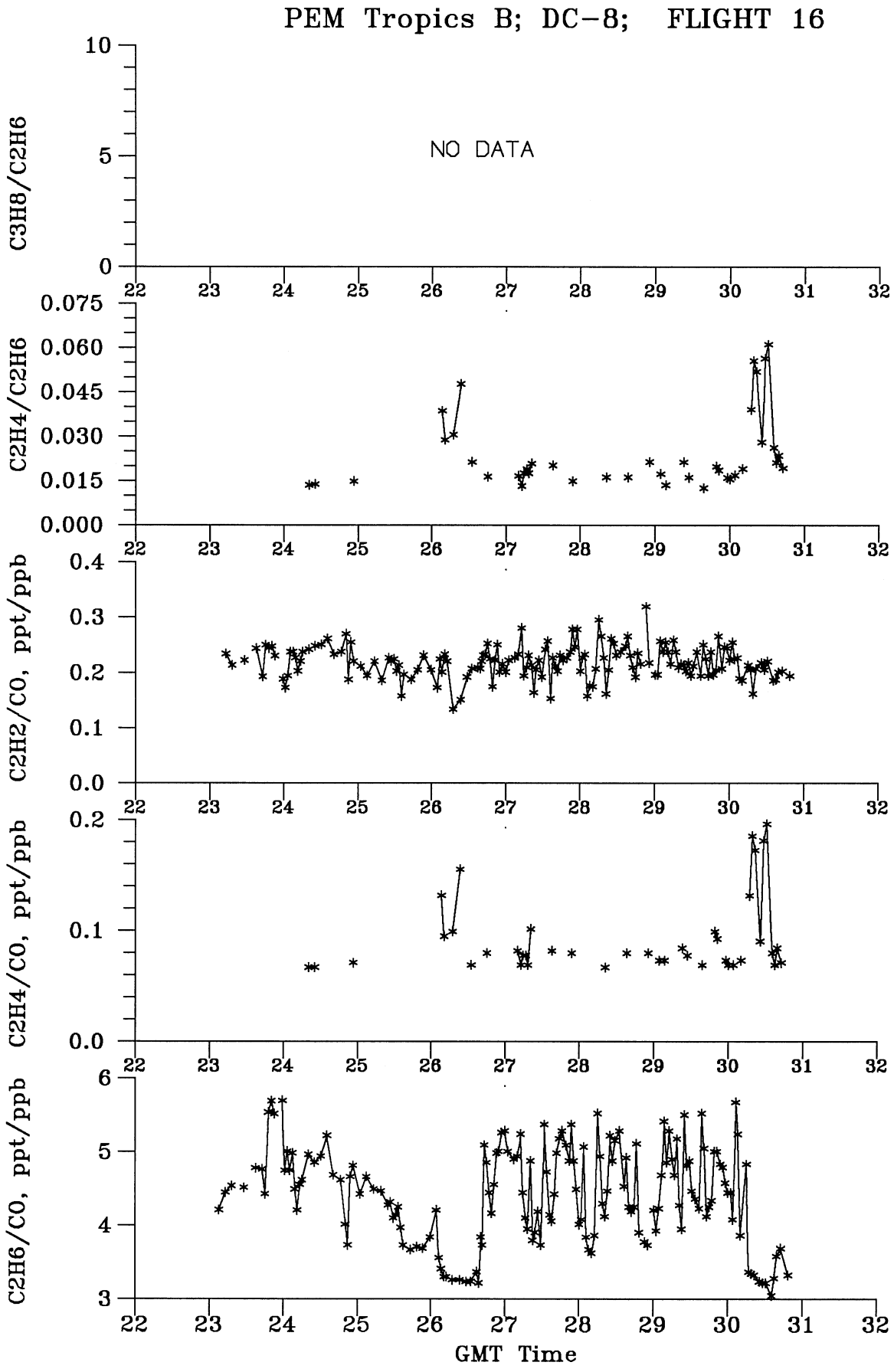
April 4, 1999

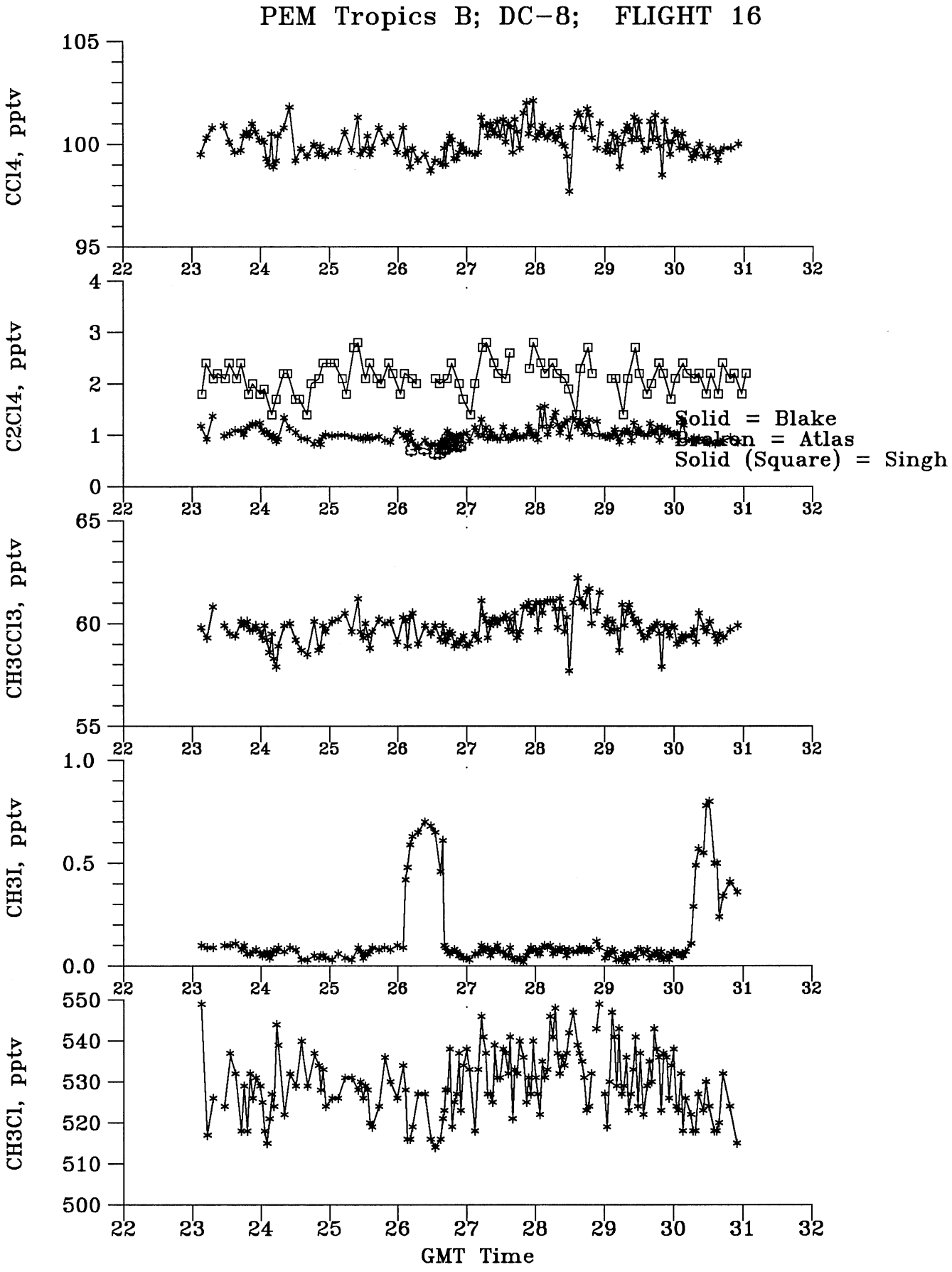

PEM Tropics B; DC-8; FLIGHT 16
North Latitude, deg.
-17
-18
-19
-20
-21
-22
-23
209
210
211
212
213
214
East Longitude, deg.
Altitude, km
15
10
5
0
22
23
24
25
26
27
28
29
30
31
32
Temperature, C
40
20
0
-20
-40
-60
-80
Solid = Static Temp
Broken = Project Dew Pt.
Rel. Hum, percent
100
50
0
Water Vapor, ppmv
20000
10000
0
GMT Time

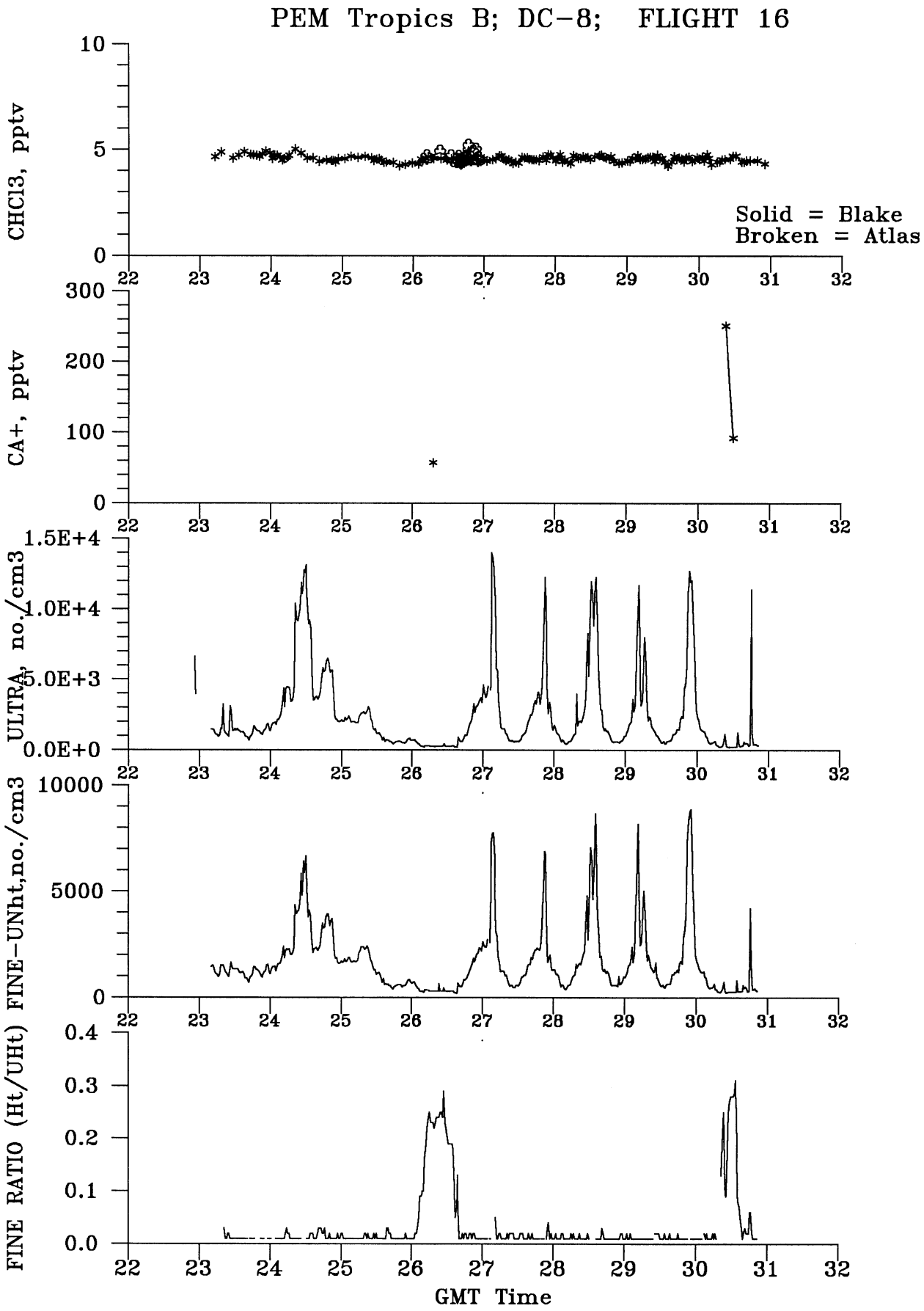

PEM Tropics B; DC-8; FLIGHT 16
O3, ppbv
40
32
24
16
8
0
CO, ppbv
50
45
40
35
30
CH4, ppbv
1750
1700
1650
CO2, ppmv
370
365
360
OH, pptv
0.50
0.25
0.00
22
23
24
25
26
27
28
29
30
31
32
GMT Time

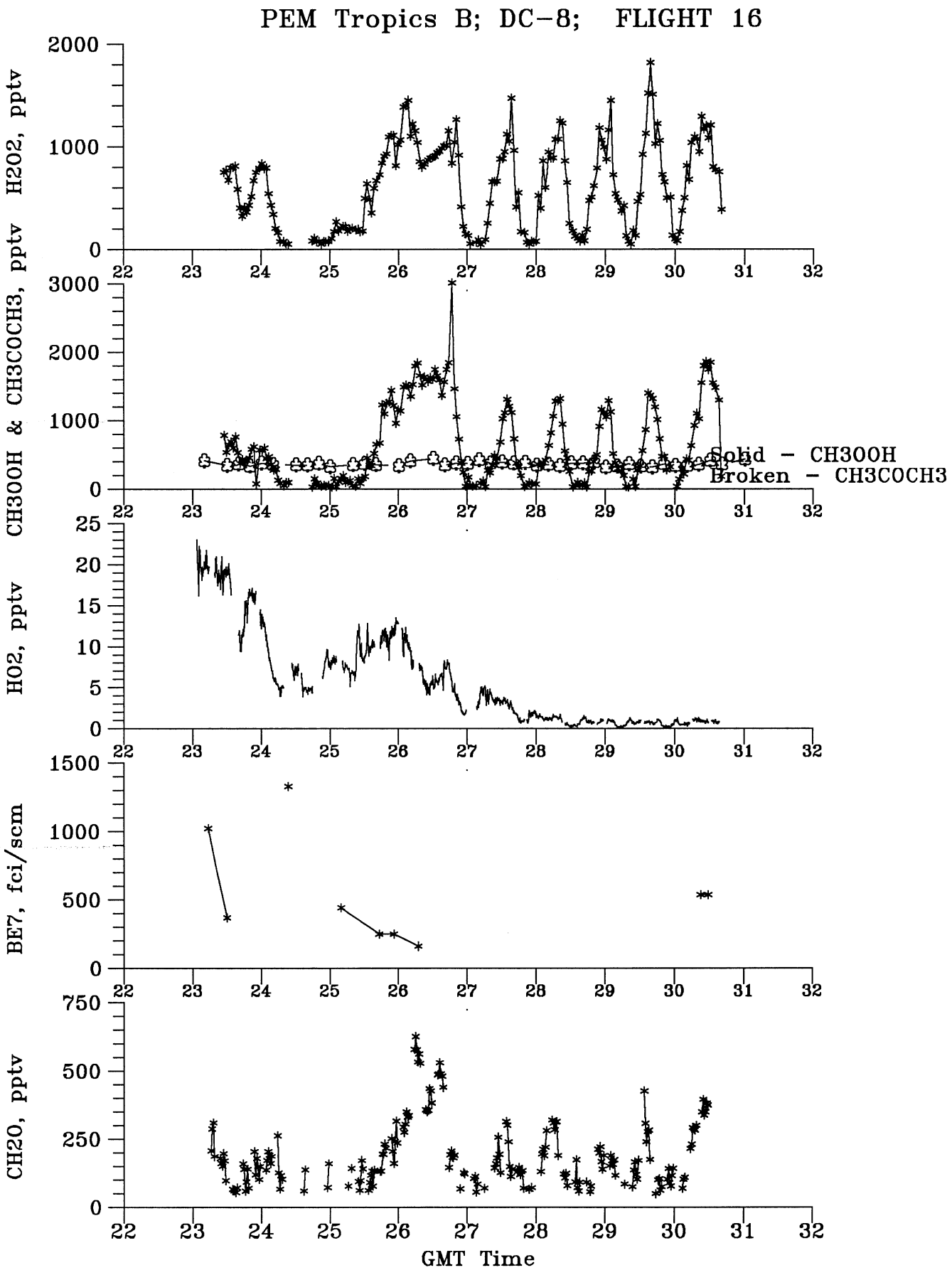

PEM Tropics B; DC-8; FLIGHT 16
NO, pptv
HNO3, pptv
NO2, pptv
SO2, pptv
DMS, pptv
GMT Time

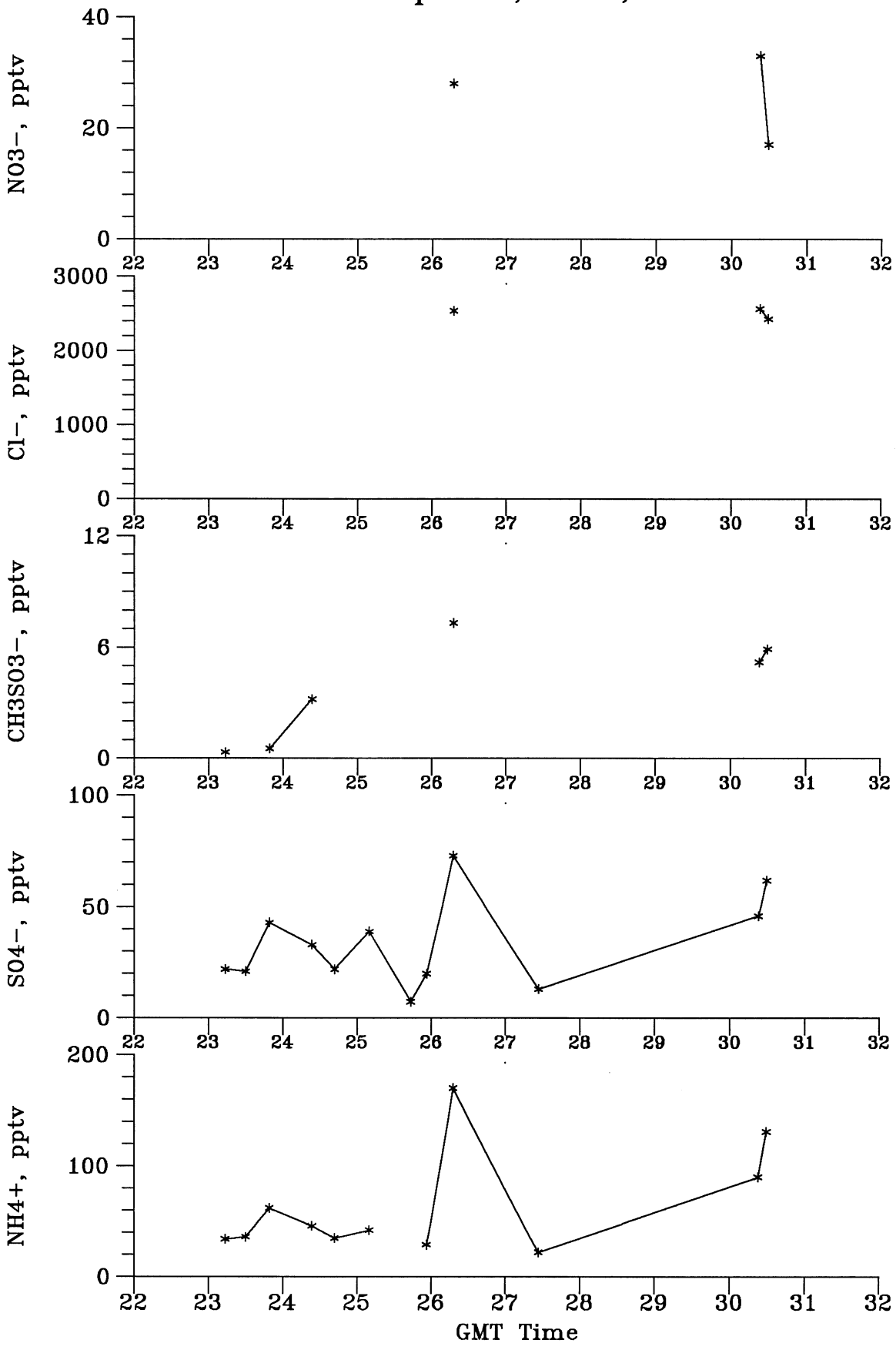

PEM Tropics B; DC-8; FLIGHT 16
C2H2, pptv
C2H4, pptv
C3H8, pptv
NO DATA
C3H6, pptv
NO DATA
C2H6, pptv
GMT Time

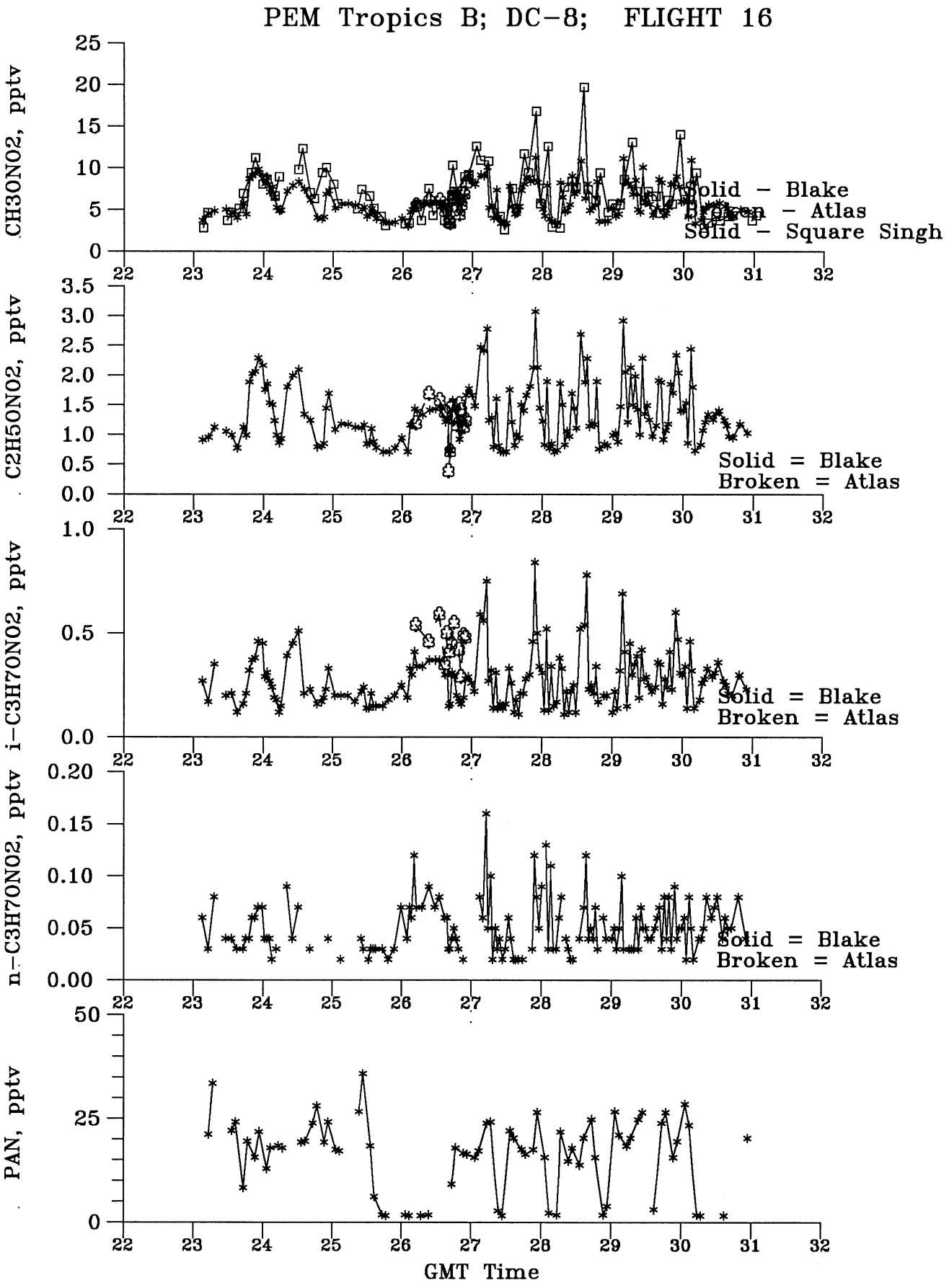

PEM Tropics B; DC-8; FLIGHT 16
C3H8/C2H6
NO DATA
C2H4/C2H6
C2H2/CO, ppt/ppb
C2H4/CO, ppt/ppb
C2H6/CO, ppt/ppb
GMT Time

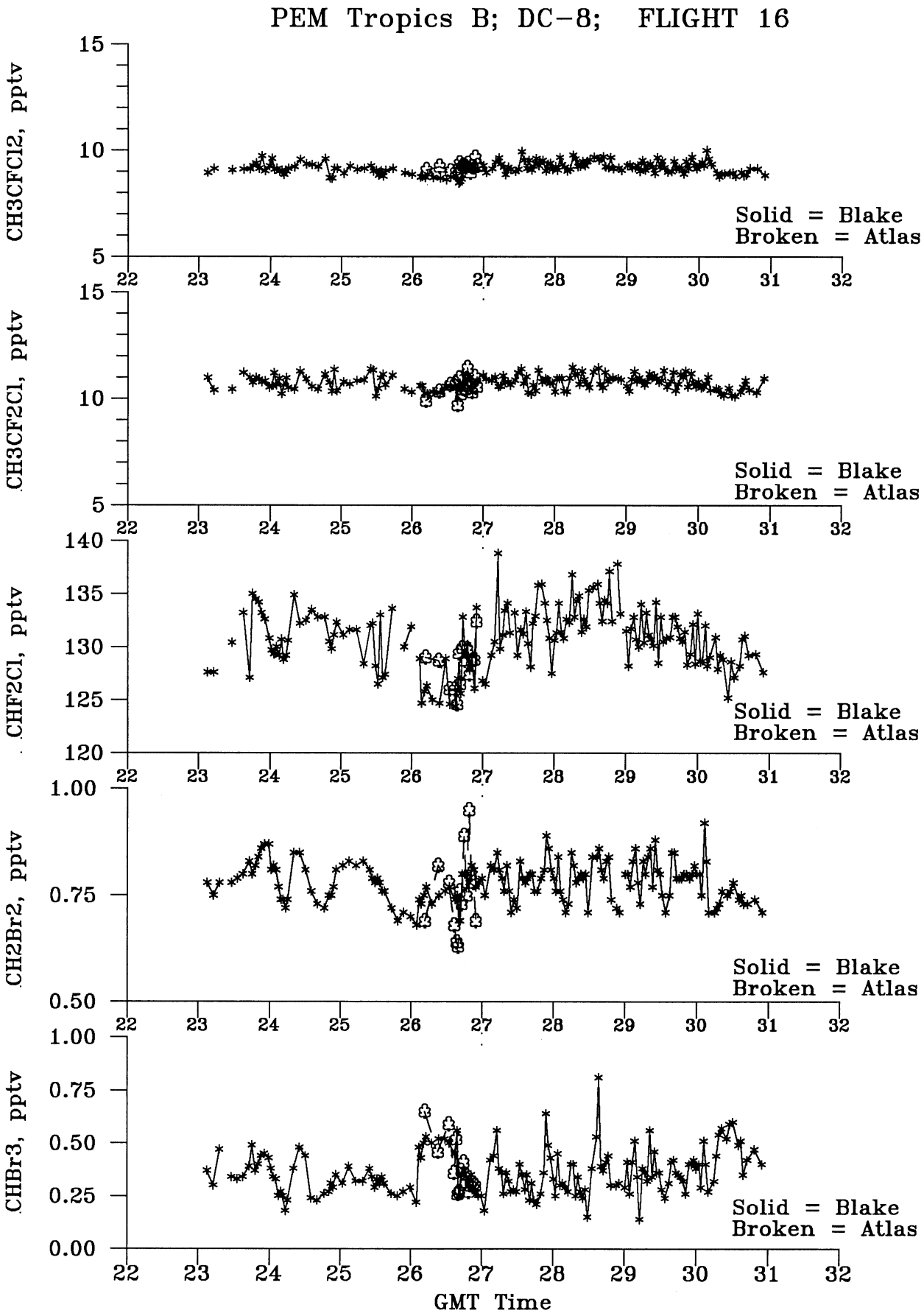

PEM Tropics B; DC-8; FLIGHT 16
CCl4, pptv
105
100
95
C2Cl4, pptv
4
3
2
1
0
Solid = Blake
Braken = Atlas
Solid (Square) = Singh
CH3CCl3, pptv
65
60
55
CH3I, pptv
1.0
0.5
0.0
CH3Cl, pptv
550
540
530
520
510
500
22
23
24
25
26
27
28
29
30
31
32
GMT Time

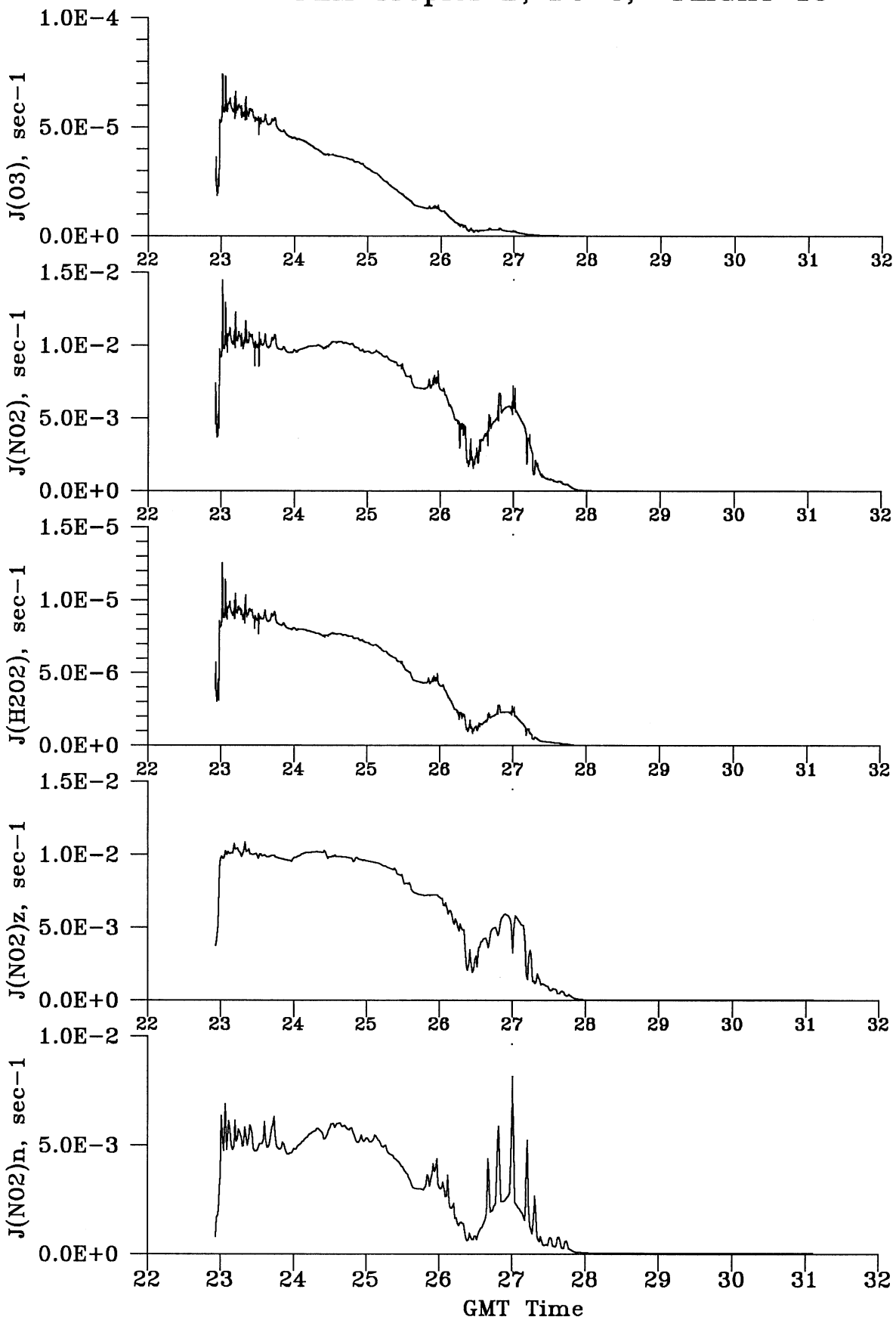

PEM Tropics B; DC-8; FLIGHT 16
CHCl3, pptv
Solid = Blake
Broken = Atlas
CA+, pptv
ULTRA, no./cm3
FINE-UNht,no./cm3
FINE RATIO (Ht/UHt)
GMT Time

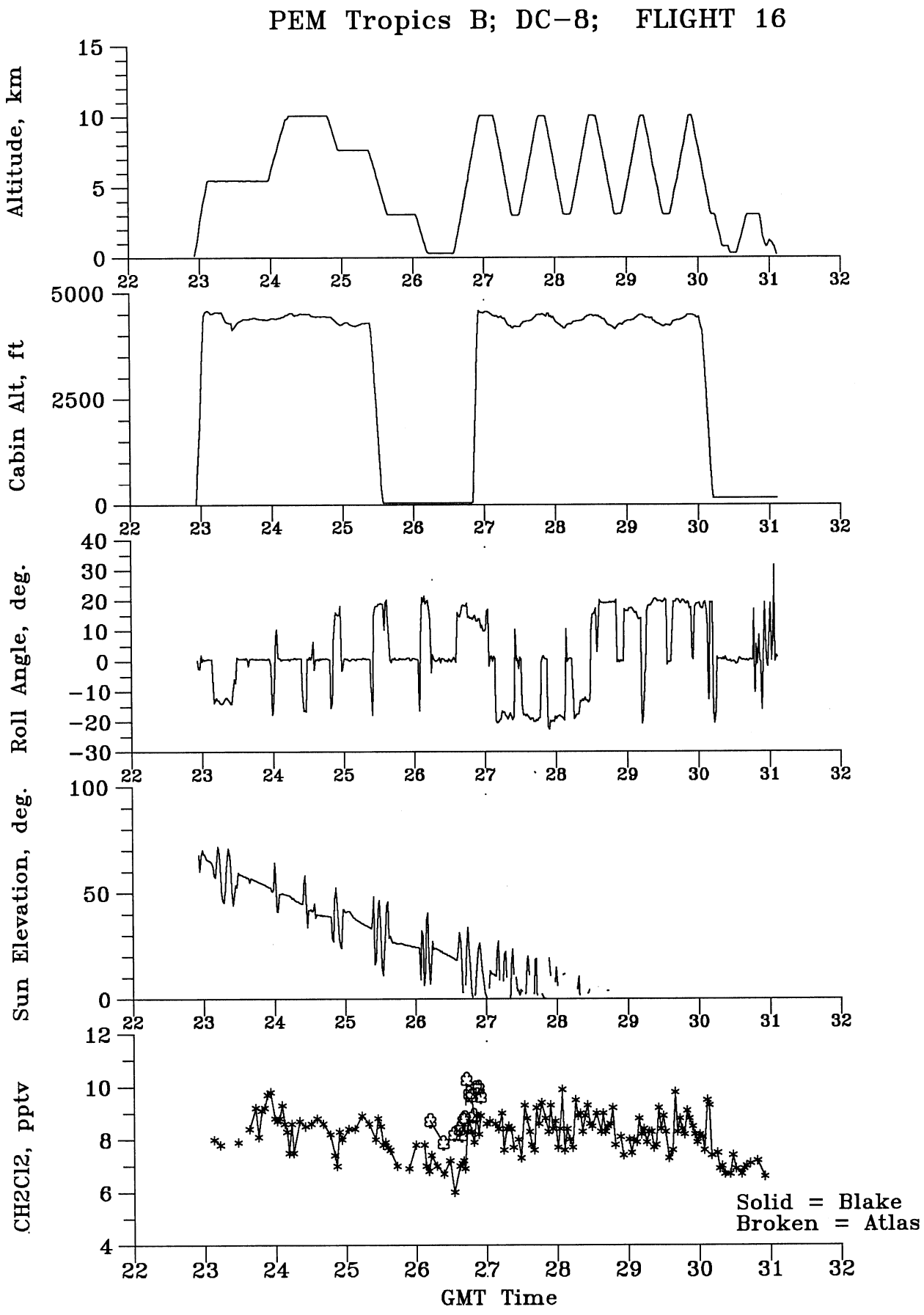

PEM Tropics B; DC-8; FLIGHT 16
H2O2, pptv
2000
1000
0
CH3OOH & CH3COCH3, pptv
3000
2000
1000
0
Solid - CH3OOH
Broken - CH3COCH3
HO2, pptv
25
20
15
10
5
0
BE7, fci/scm
1500
1000
500
0
CH2O, pptv
750
500
250
0
22
23
24
25
26
27
28
29
30
31
32
GMT Time


PEM Tropics B; DC-8; FLIGHT 16
NO3-, pptv
Cl-, pptv
CH3SO3-, pptv
SO4-, pptv
NH4+, pptv
GMT Time
22
23
24
25
26
27
28
29
30
31
32

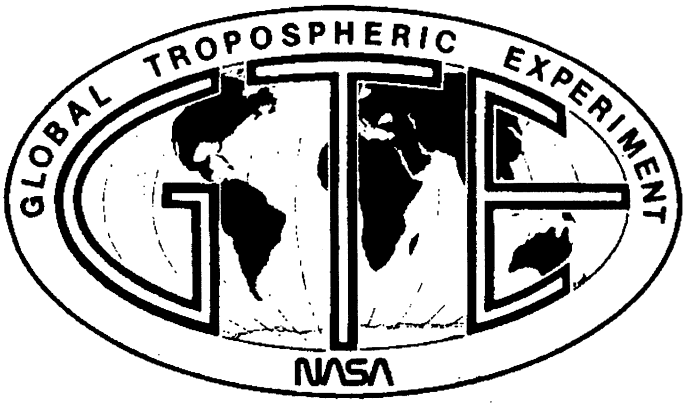

PEM Tropics B; DC-8; FLIGHT 16
CH3ON02, pptv
Solid - Blake
Broken - Atlas
Solid - Square Singh
C2H5ON02, pptv
Solid = Blake
Broken = Atlas
i-C3H7ON02, pptv
Solid = Blake
Broken = Atlas
n-C3H7ON02, pptv
Solid = Blake
Broken = Atlas
PAN, pptv
GMT Time


PEM Tropics B; DC-8; FLIGHT 16
CH3CFCl2, pptv
15
10
5
Solid = Blake
Broken = Atlas
CH3CF2Cl, pptv
15
10
5
Solid = Blake
Broken = Atlas
CHF2Cl, pptv
140
135
130
125
120
Solid = Blake
Broken = Atlas
CH2Br2, pptv
1.00
0.75
0.50
Solid = Blake
Broken = Atlas
CHBr3, pptv
1.00
0.75
0.50
0.25
0.00
Solid = Blake
Broken = Atlas
22 23 24 25 26 27 28 29 30 31 32
GMT Time


PEM Tropics B; DC-8; FLIGHT 16
J(O3), sec-1
1.0E-4
5.0E-5
0.0E+0
J(NO2), sec-1
1.5E-2
1.0E-2
5.0E-3
0.0E+0
J(H2O2), sec-1
1.5E-5
1.0E-5
5.0E-6
0.0E+0
J(NO2)z, sec-1
1.5E-2
1.0E-2
5.0E-3
0.0E+0
J(NO2)n, sec-1
1.0E-2
5.0E-3
0.0E+0
22 23 24 25 26 27 28 29 30 31 32
GMT Time


PEM Tropics B; DC-8; FLIGHT 16
Altitude, km
15
10
5
0
Cabin Alt, ft
5000
2500
0
Roll Angle, deg.
40
30
20
10
0
-10
-20
-30
Sun Elevation, deg.
100
50
0
CH2Cl2, pptv
12
10
8
6
4
22
23
24
25
26
27
28
29
30
31
32
GMT Time
Solid = Blake
Broken = Atlas

PLOTS OF FINAL CHEMICAL DATA



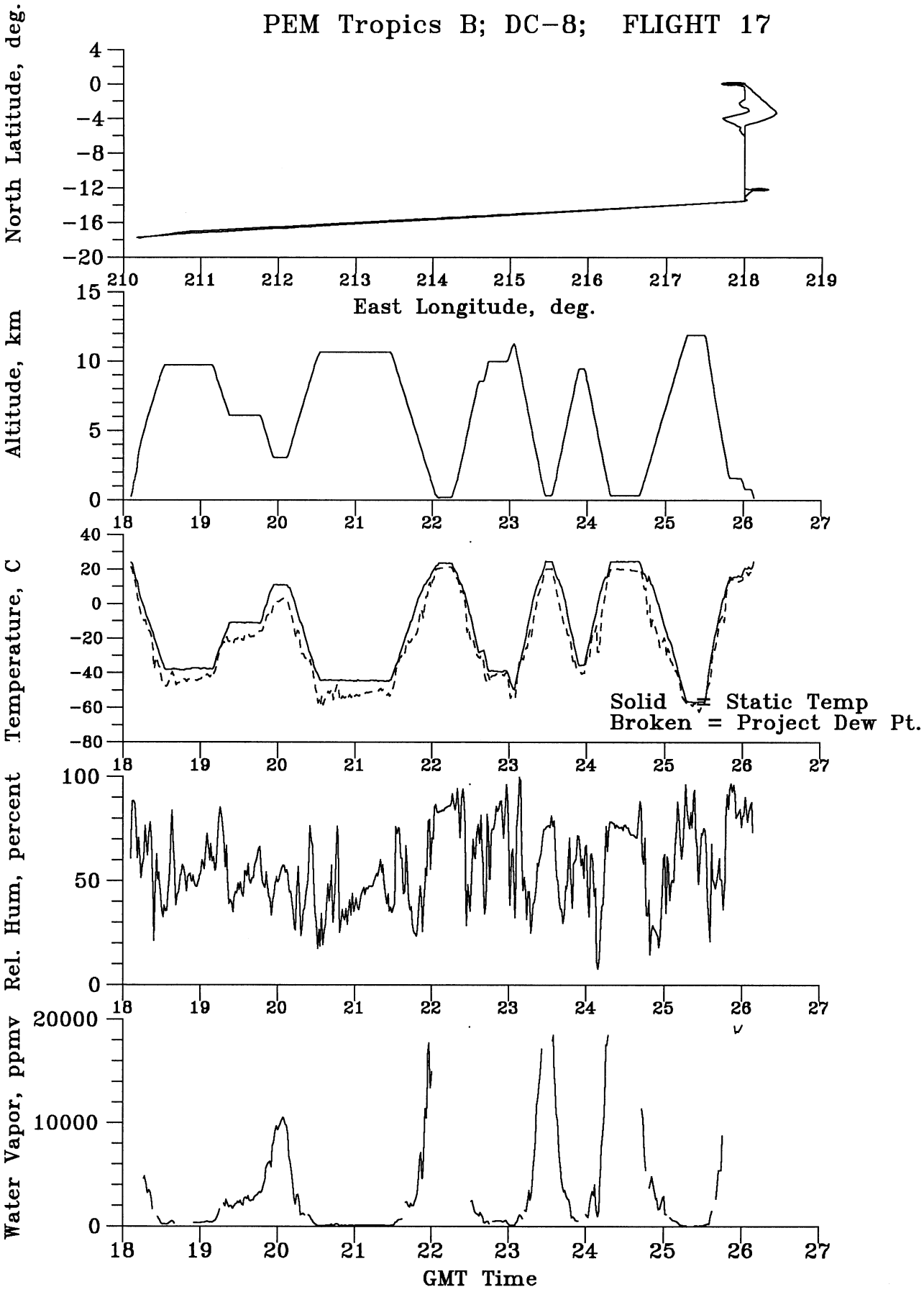
PEM-TROPICS B

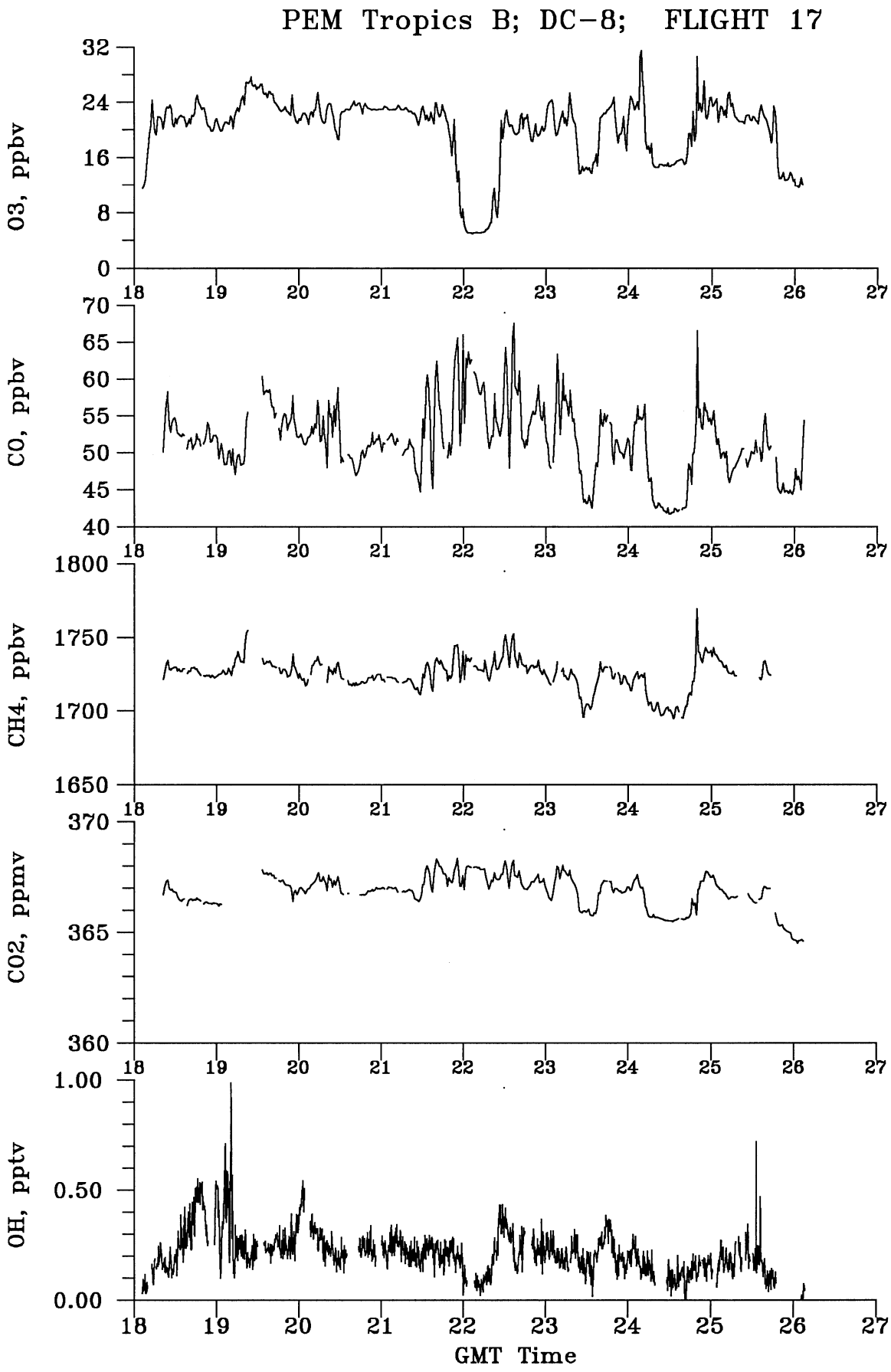
Flight 17D

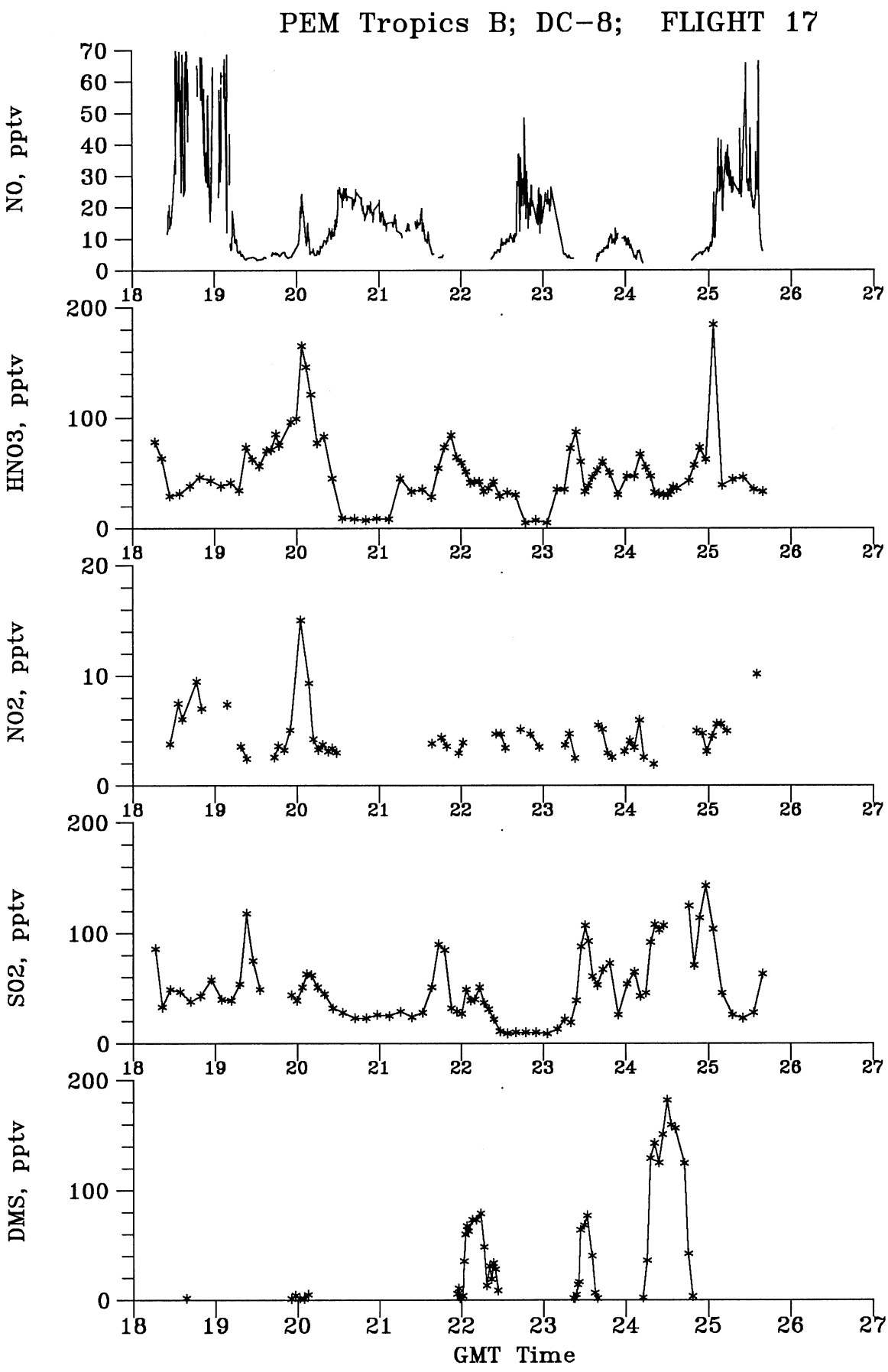
Local: Tahiti No. 4

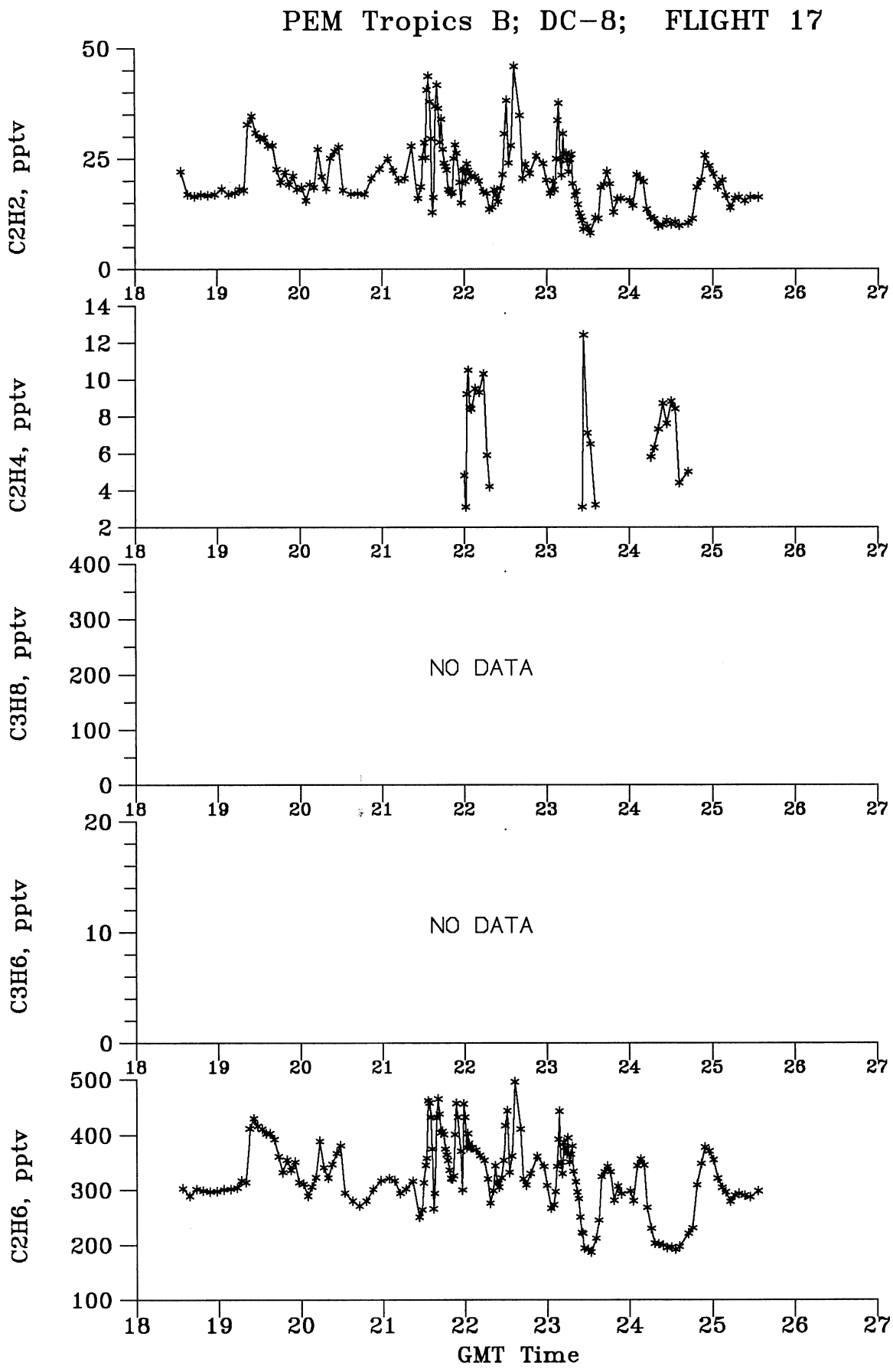
ITCZ Inflow/Outflow

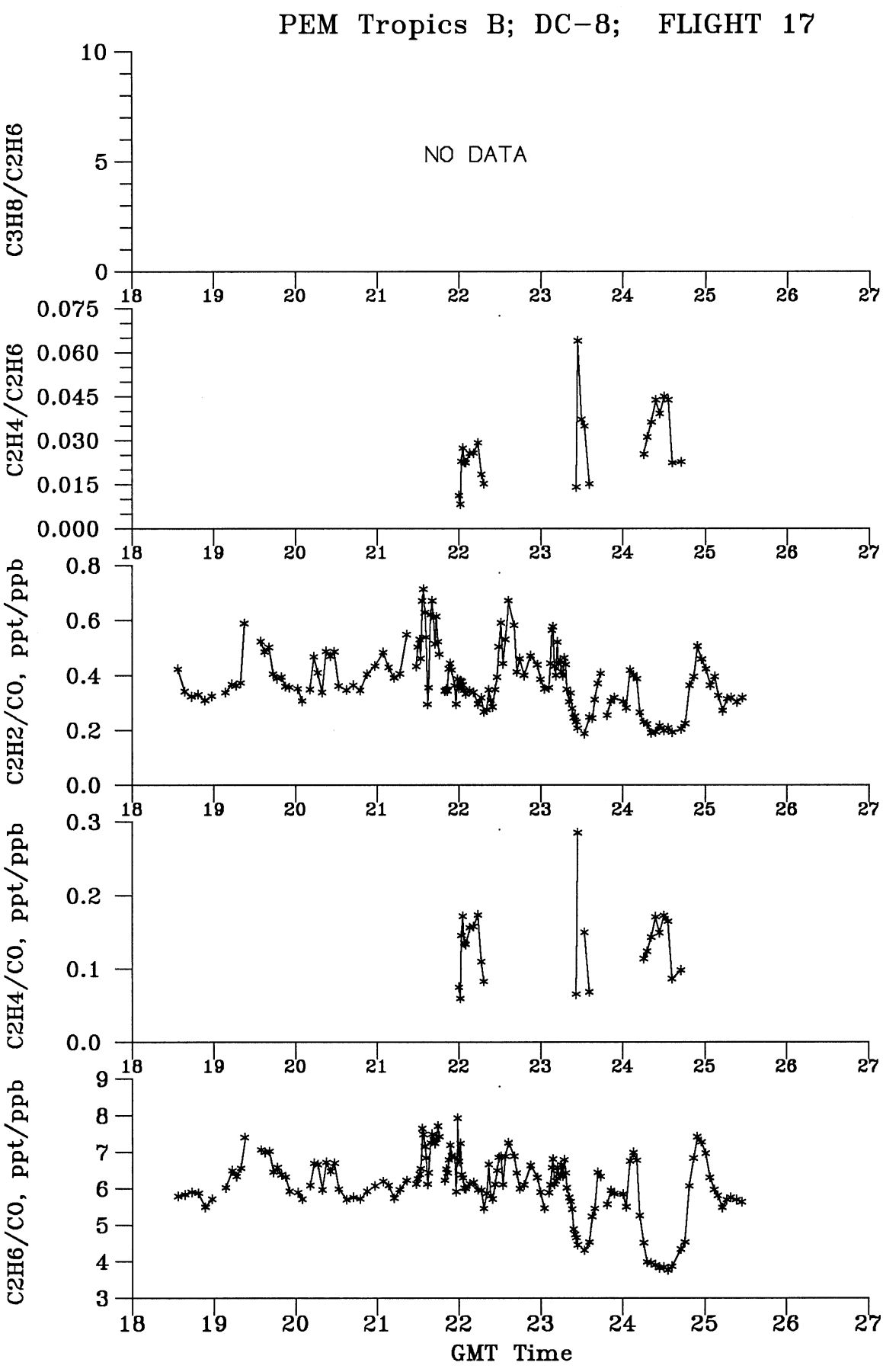
April 7, 1999

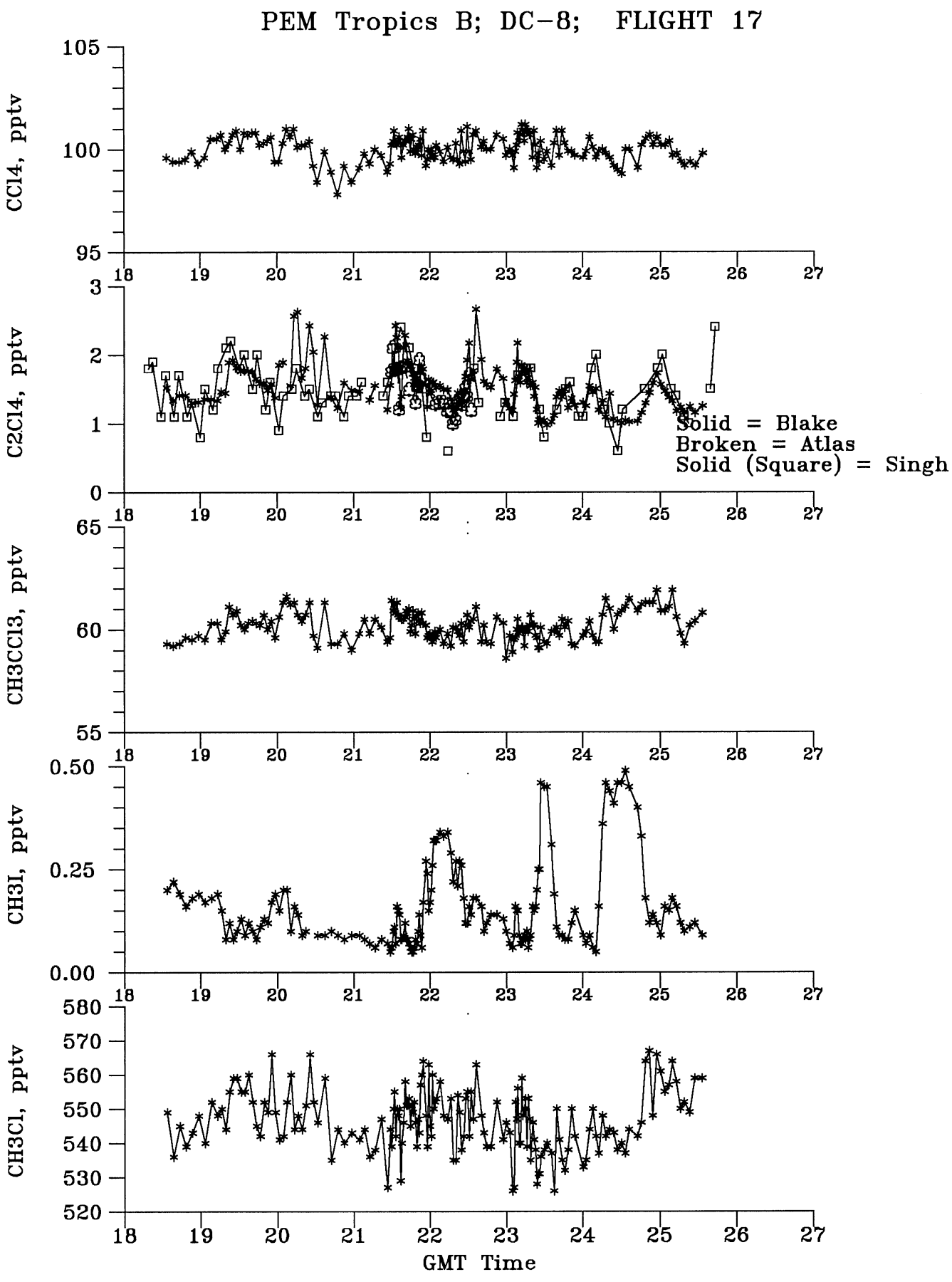

PEM Tropics B; DC-8; FLIGHT 17
North Latitude, deg.
4
0
-4
-8
-12
-16
-20
210
211
212
213
214
215
216
217
218
219
East Longitude, deg.
Altitude, km
15
10
5
0
18
19
20
21
22
23
24
25
26
27
Temperature, C
40
20
0
-20
-40
-60
-80
Solid = Static Temp
Broken = Project Dew Pt.
Rel. Hum, percent
100
50
0
Water Vapor, ppmv
20000
10000
0
GMT Time

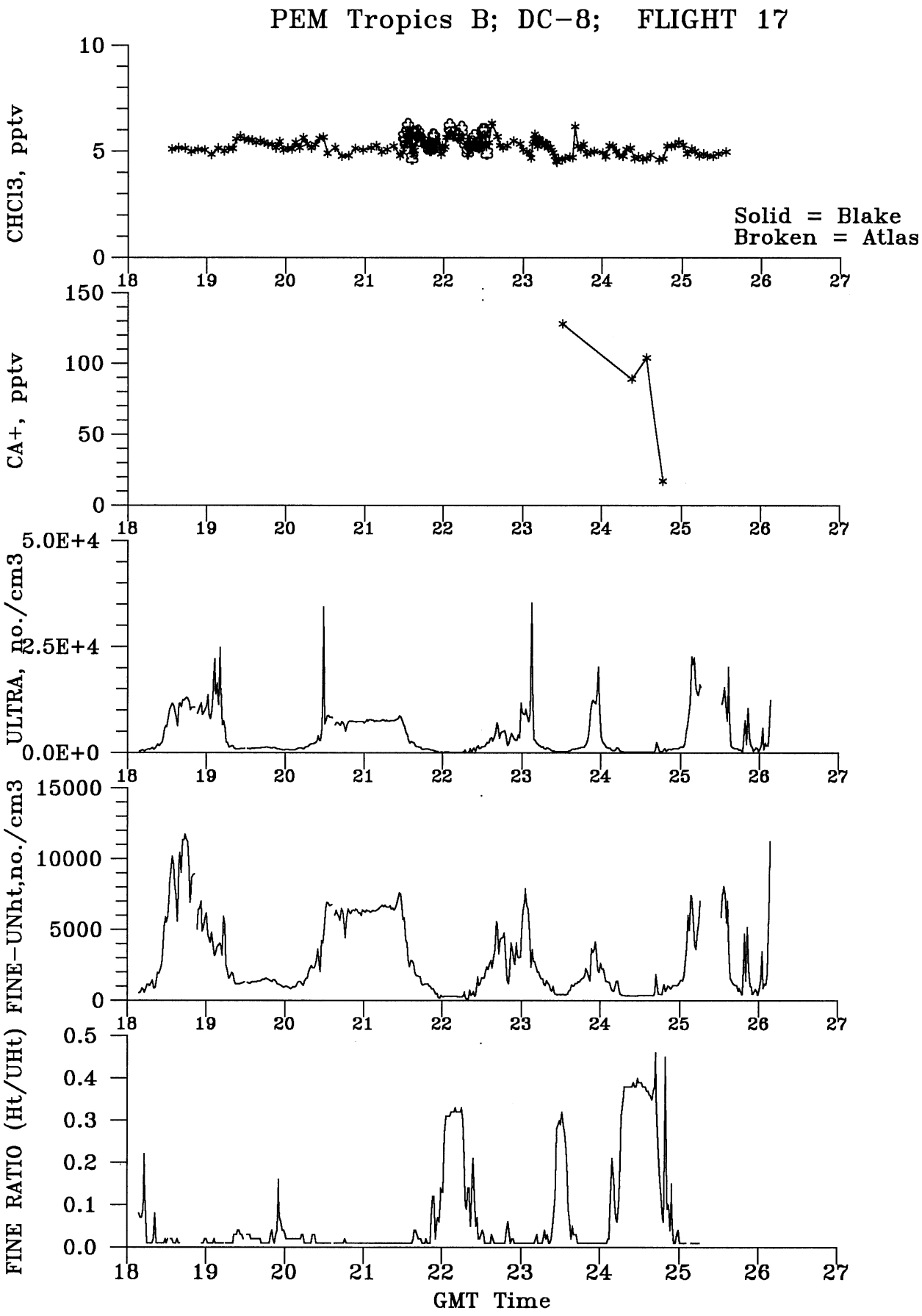

PEM Tropics B; DC-8; FLIGHT 17
O3, ppbv
32
24
16
8
0
CO, ppbv
70
65
60
55
50
45
40
CH4, ppbv
1800
1750
1700
1650
CO2, ppmv
370
365
360
OH, pptv
1.00
0.50
0.00
18
19
20
21
22
23
24
25
26
27
GMT Time

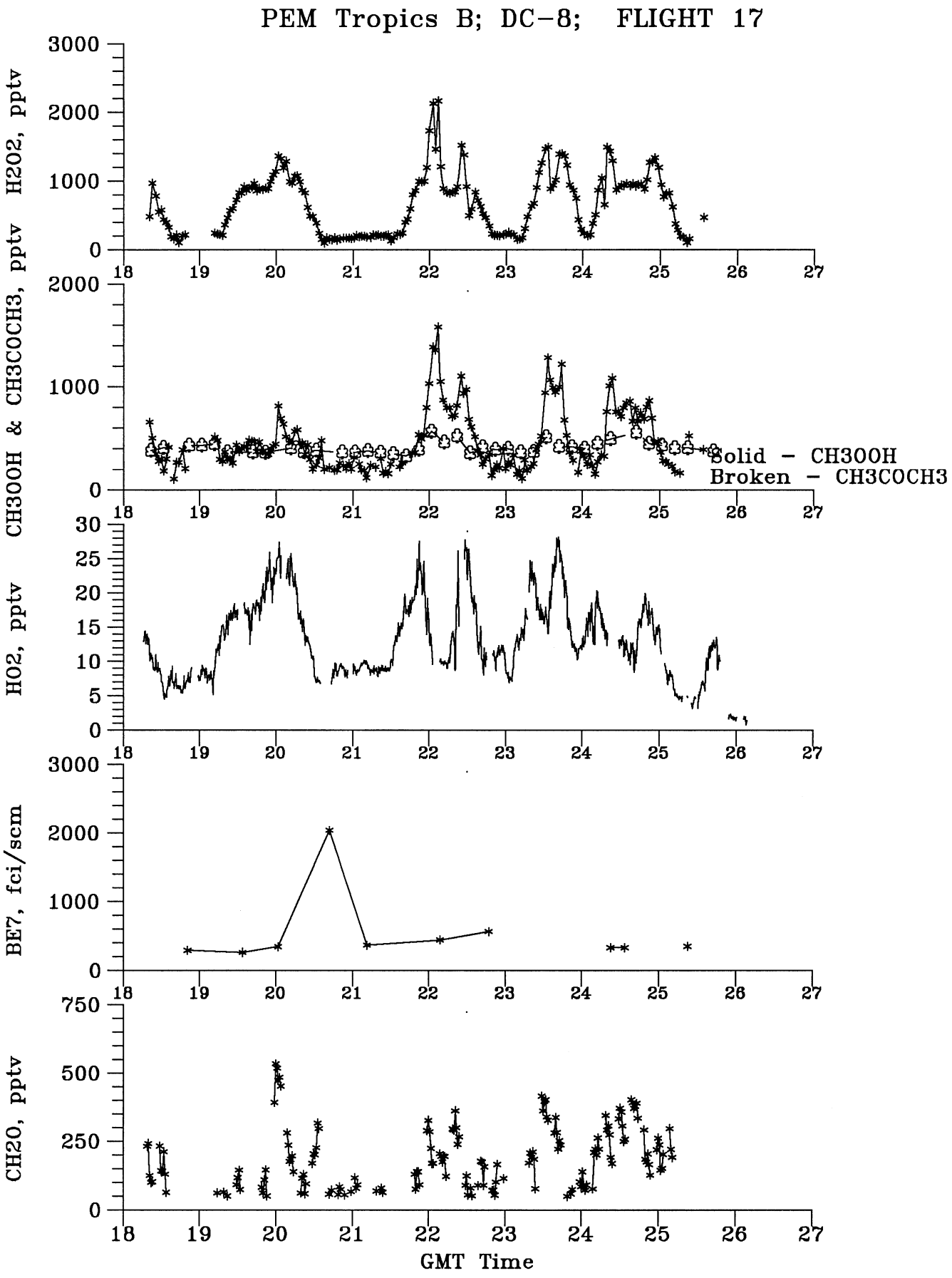

PEM Tropics B; DC-8; FLIGHT 17
NO, pptv
HNO3, pptv
NO2, pptv
SO2, pptv
DMS, pptv
GMT Time

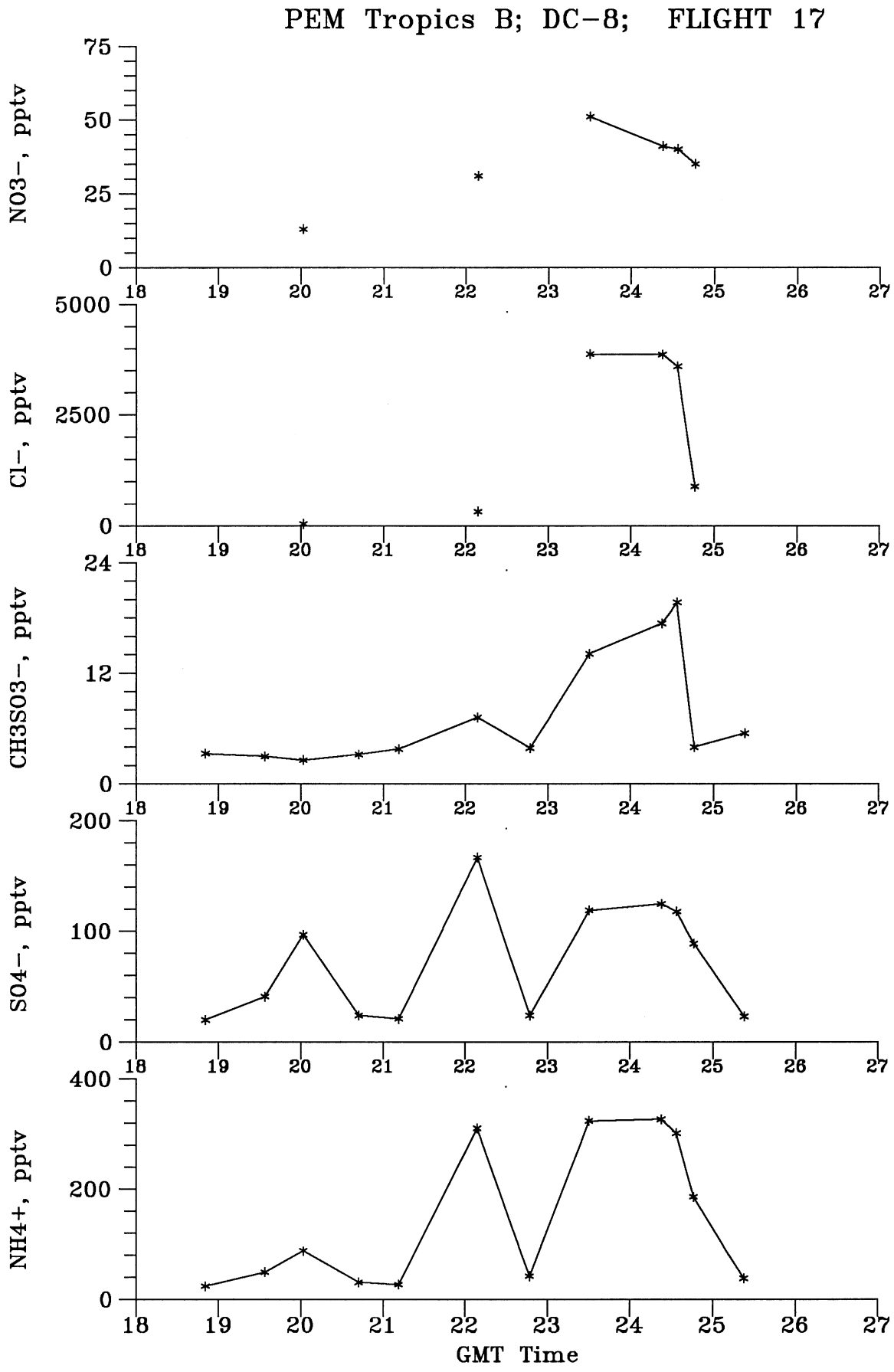

PEM Tropics B; DC-8; FLIGHT 17
C2H2, pptv
50
25
0
C2H4, pptv
14
12
10
8
6
4
2
C3H8, pptv
400
300
200
100
0
NO DATA
C3H6, pptv
20
10
0
NO DATA
C2H6, pptv
500
400
300
200
100
18
19
20
21
22
23
24
25
26
27
GMT Time

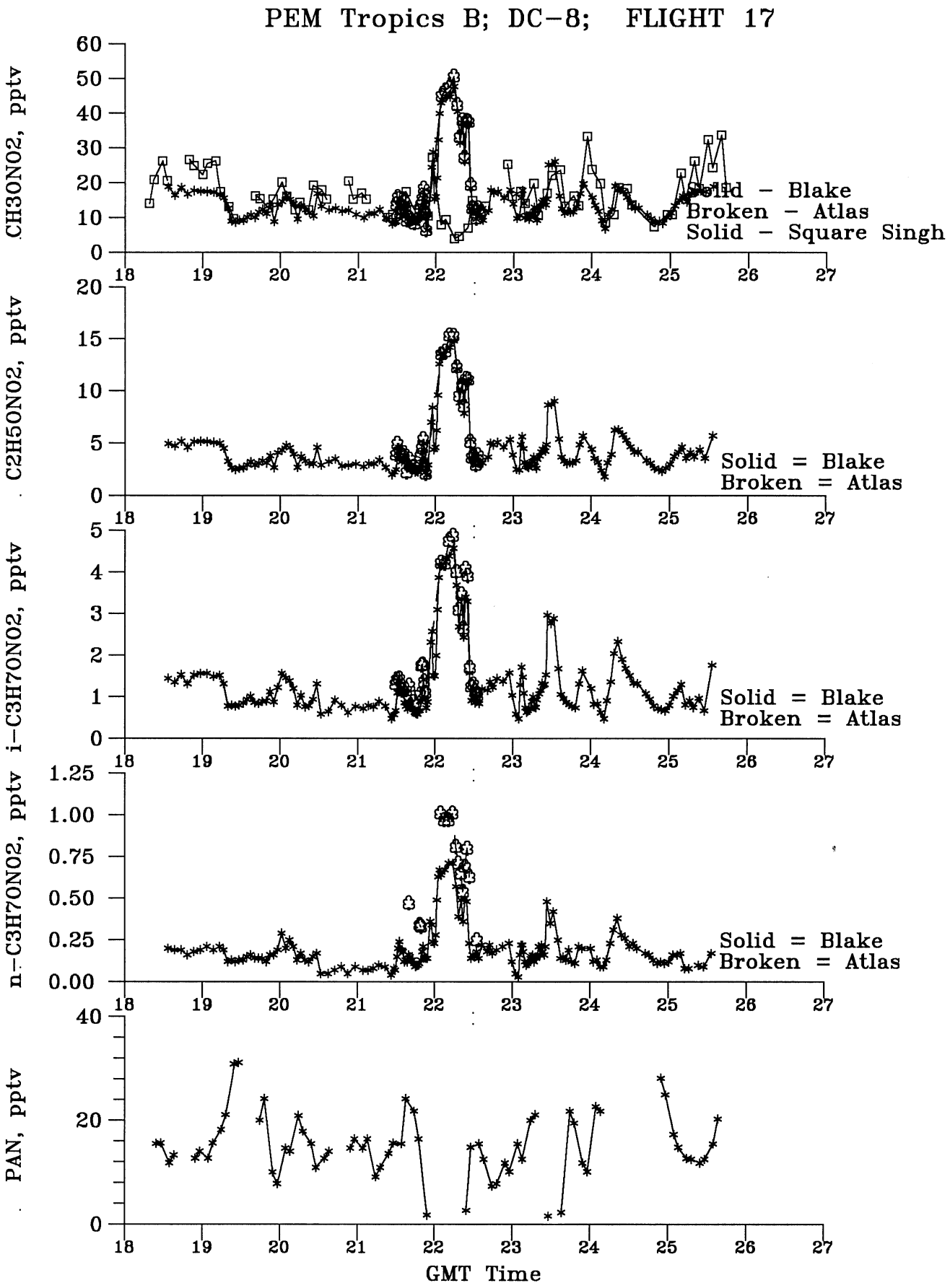

PEM Tropics B; DC-8; FLIGHT 17
C3H8/C2H6
NO DATA
C2H4/C2H6
C2H2/CO, ppt/ppb
C2H4/CO, ppt/ppb
C2H6/CO, ppt/ppb
GMT Time

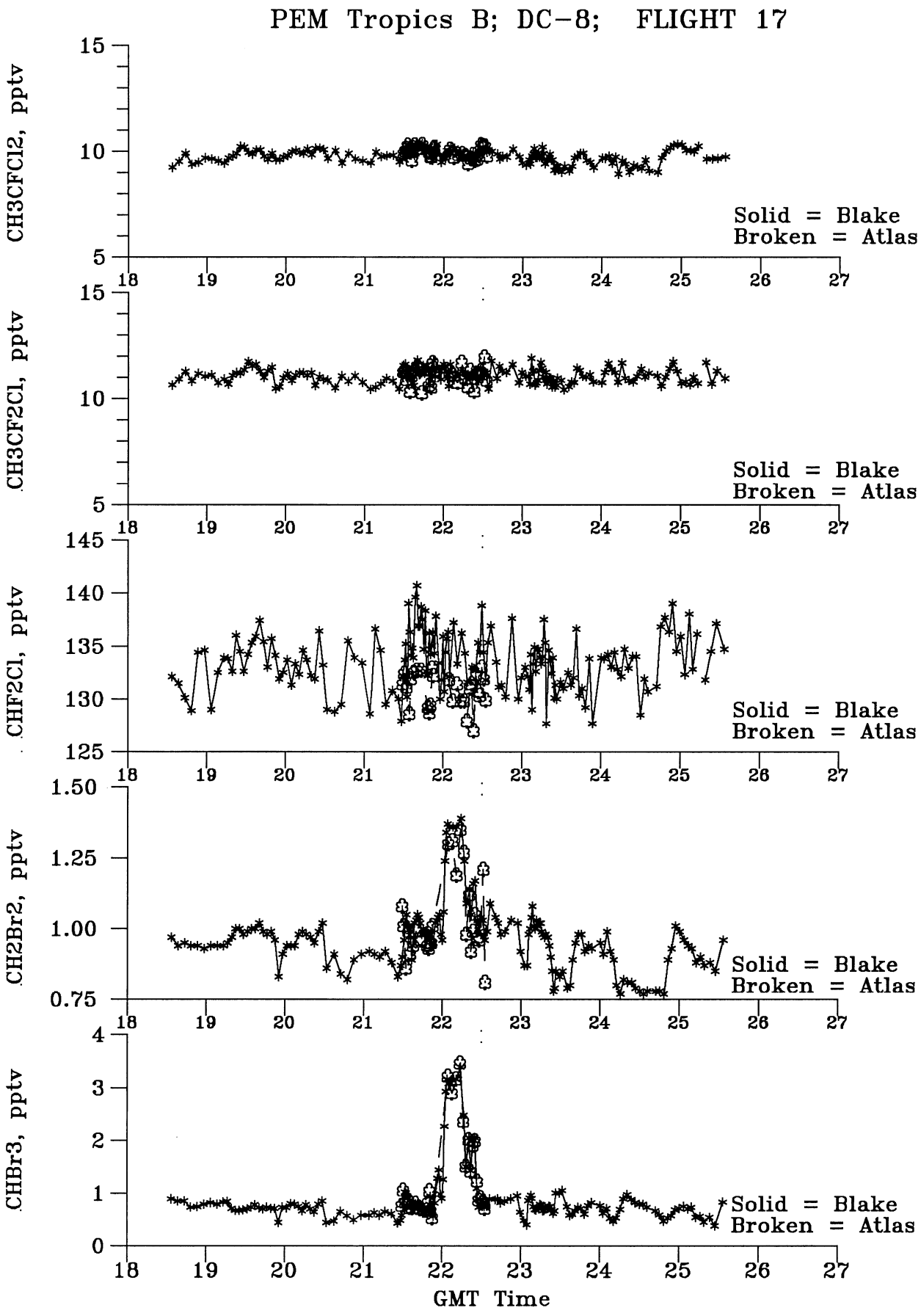

PEM Tropics B; DC-8; FLIGHT 17
CCl4, pptv
105
100
95
C2Cl4, pptv
3
2
1
0
Solid = Blake
Broken = Atlas
Solid (Square) = Singh
CH3CCl3, pptv
65
60
55
CH3I, pptv
0.50
0.25
0.00
CH3Cl, pptv
580
570
560
550
540
530
520
18
19
20
21
22
23
24
25
26
27
GMT Time

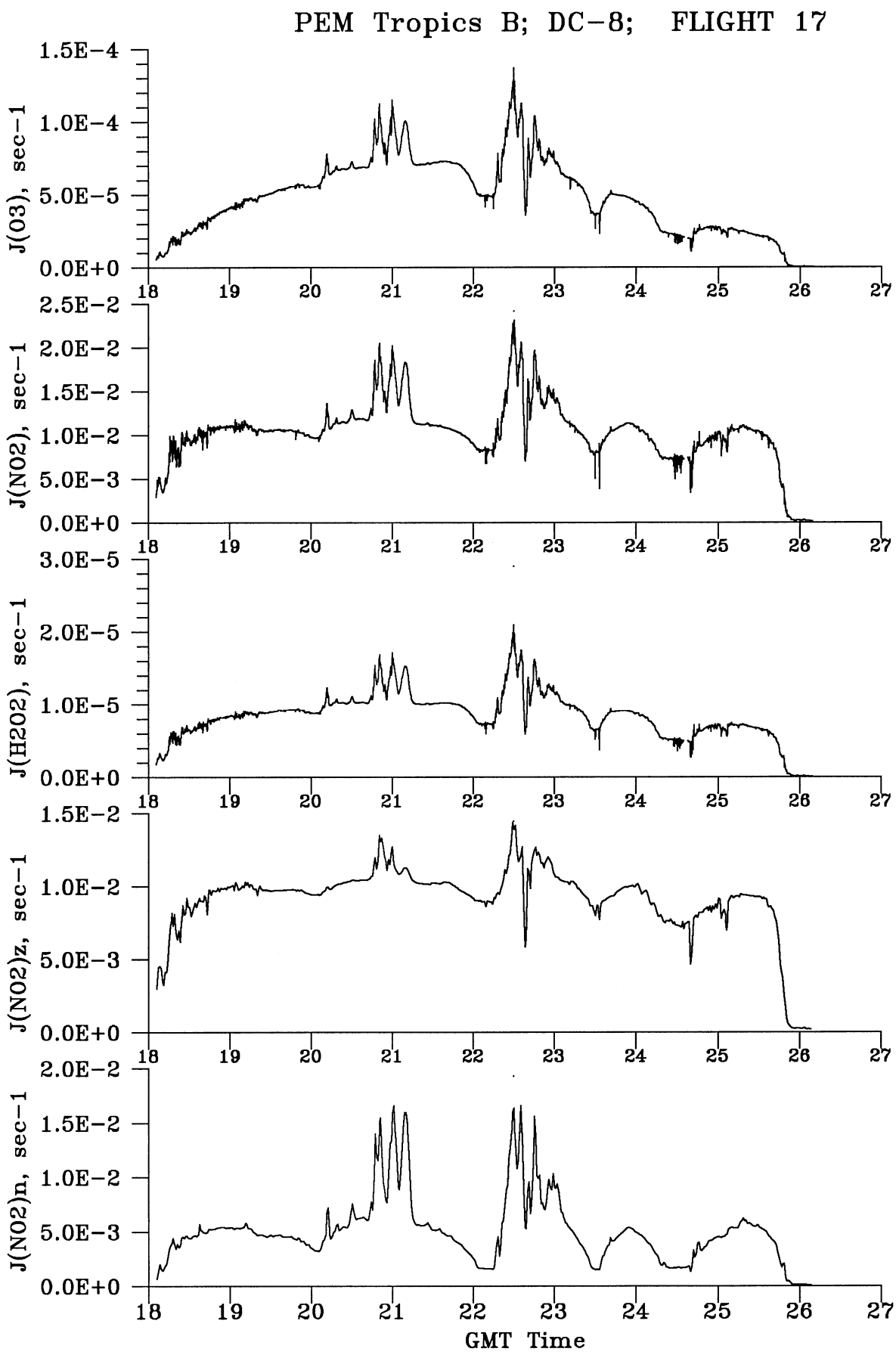

PEM Tropics B; DC-8; FLIGHT 17
CHCl3, pptv
Solid = Blake
Broken = Atlas
CA+, pptv
ULTRA, no./cm3
FINE-UNht,no./cm3
FINE RATIO (Ht/UHt)
GMT Time

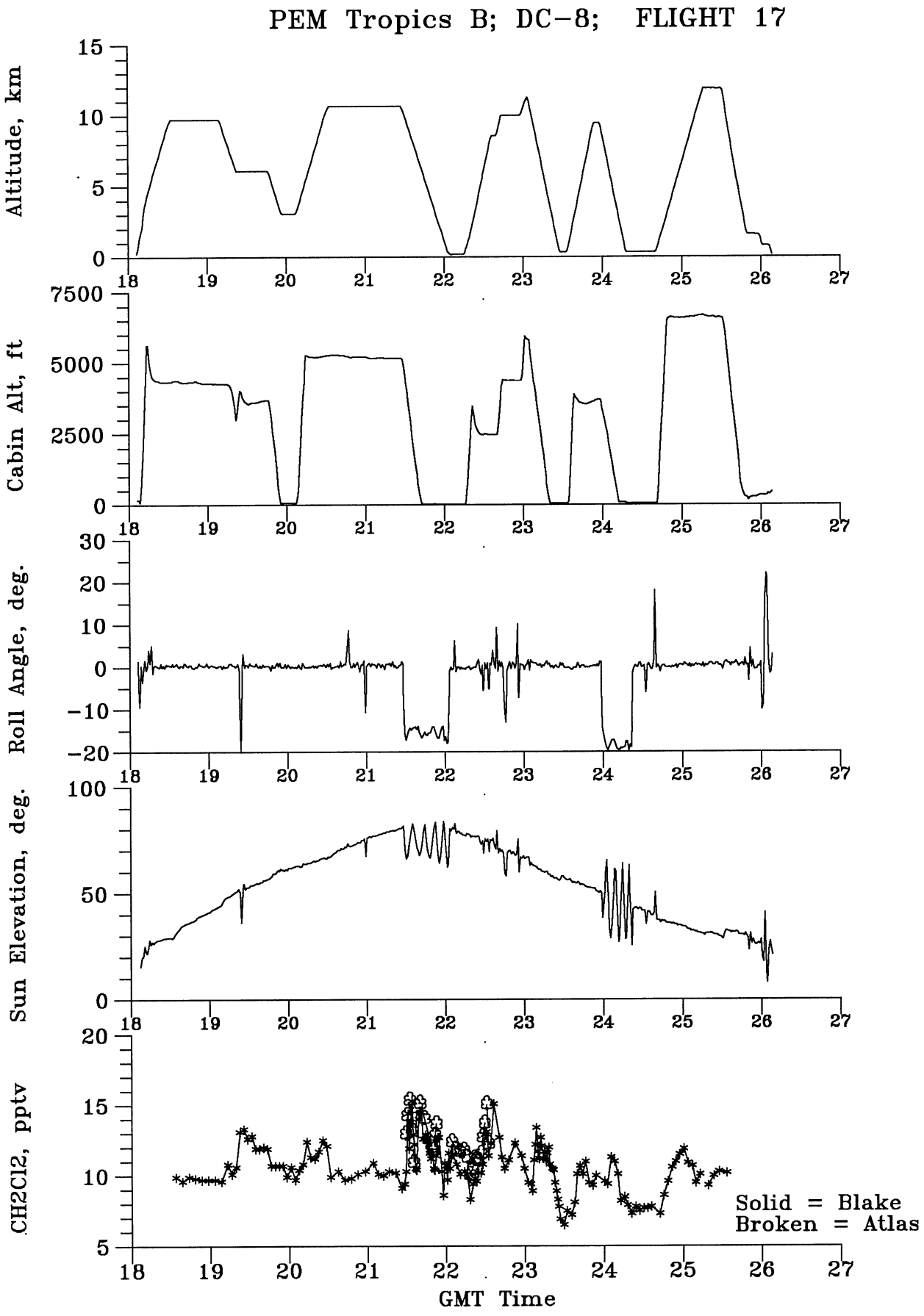

PEM Tropics B; DC-8; FLIGHT 17
H2O2, pptv
3000
2000
1000
0
CH3OOH & CH3COCH3, pptv
2000
1000
0
Solid - CH3OOH
Broken - CH3COCH3
HO2, pptv
30
25
20
15
10
5
0
BE7, fci/scm
3000
2000
1000
0
CH2O, pptv
750
500
250
0
18
19
20
21
22
23
24
25
26
27
GMT Time


PEM Tropics B; DC-8; FLIGHT 17
NO3-, pptv
75
50
25
0
Cl-, pptv
5000
2500
0
CH3SO3-, pptv
24
12
0
SO4-, pptv
200
100
0
NH4+, pptv
400
200
0
18
19
20
21
22
23
24
25
26
27
GMT Time

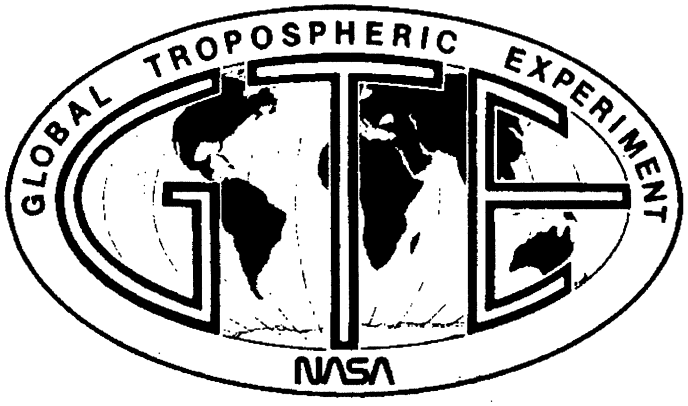

PEM Tropics B; DC-8; FLIGHT 17
CH3ONO2, pptv
Solid - Blake
Broken - Atlas
Solid - Square Singh
C2H5ONO2, pptv
Solid = Blake
Broken = Atlas
i-C3H7ONO2, pptv
Solid = Blake
Broken = Atlas
n-C3H7ONO2, pptv
Solid = Blake
Broken = Atlas
PAN, pptv
GMT Time


PEM Tropics B; DC-8; FLIGHT 17
CH3CFCl2, pptv
15
10
5
Solid = Blake
Broken = Atlas
CH3CF2Cl, pptv
15
10
5
Solid = Blake
Broken = Atlas
CHF2Cl, pptv
145
140
135
130
125
Solid = Blake
Broken = Atlas
CH2Br2, pptv
1.50
1.25
1.00
0.75
Solid = Blake
Broken = Atlas
CHBr3, pptv
4
3
2
1
0
Solid = Blake
Broken = Atlas
18
19
20
21
22
23
24
25
26
27
GMT Time


PEM Tropics B; DC-8; FLIGHT 17
J(O3), sec-1
1.5E-4
1.0E-4
5.0E-5
0.0E+0
J(NO2), sec-1
2.5E-2
2.0E-2
1.5E-2
1.0E-2
5.0E-3
0.0E+0
J(H2O2), sec-1
3.0E-5
2.0E-5
1.0E-5
0.0E+0
J(NO2)z, sec-1
1.5E-2
1.0E-2
5.0E-3
0.0E+0
J(NO2)n, sec-1
2.0E-2
1.5E-2
1.0E-2
5.0E-3
0.0E+0
18
19
20
21
22
23
24
25
26
27
GMT Time


PEM Tropics B; DC-8; FLIGHT 17
Altitude, km
15
10
5
0
Cabin Alt, ft
7500
5000
2500
0
Roll Angle, deg.
30
20
10
0
−10
−20
Sun Elevation, deg.
100
50
0
CH2Cl2, pptv
20
15
10
5
18
19
20
21
22
23
24
25
26
27
GMT Time
Solid = Blake
Broken = Atlas

PLOTS OF FINAL CHEMICAL DATA



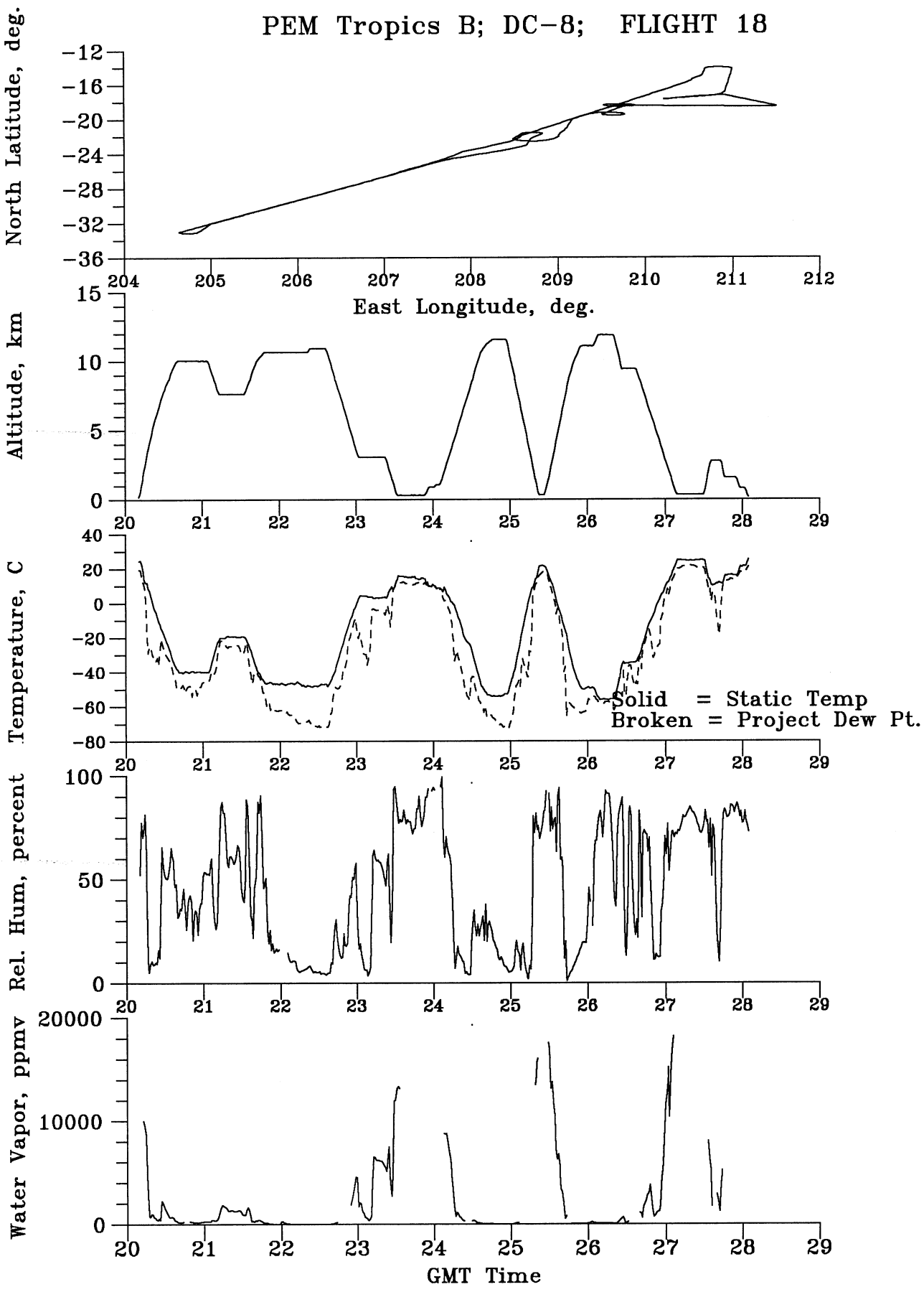
PEM-TROPICS B

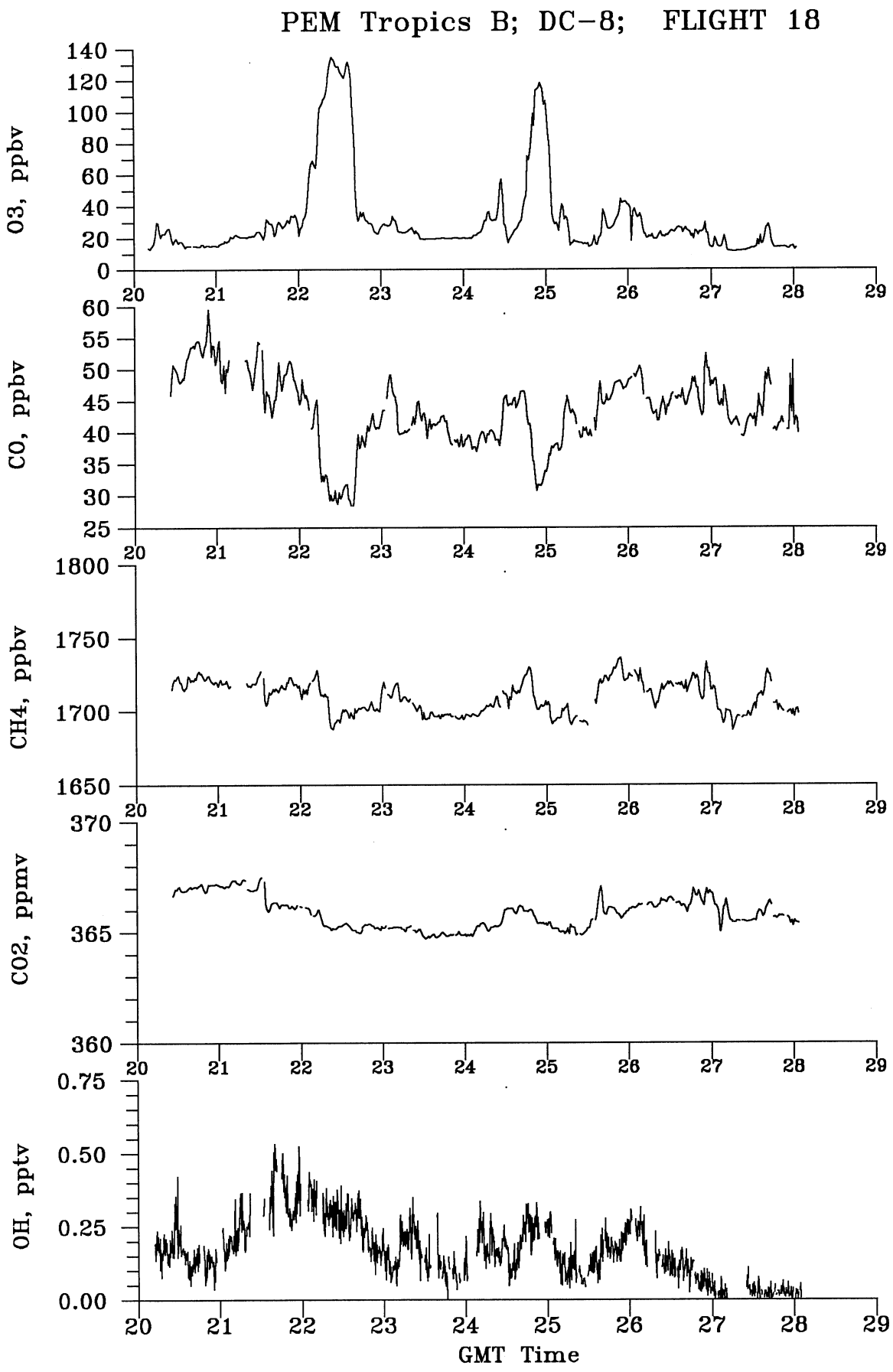
Flight 18D

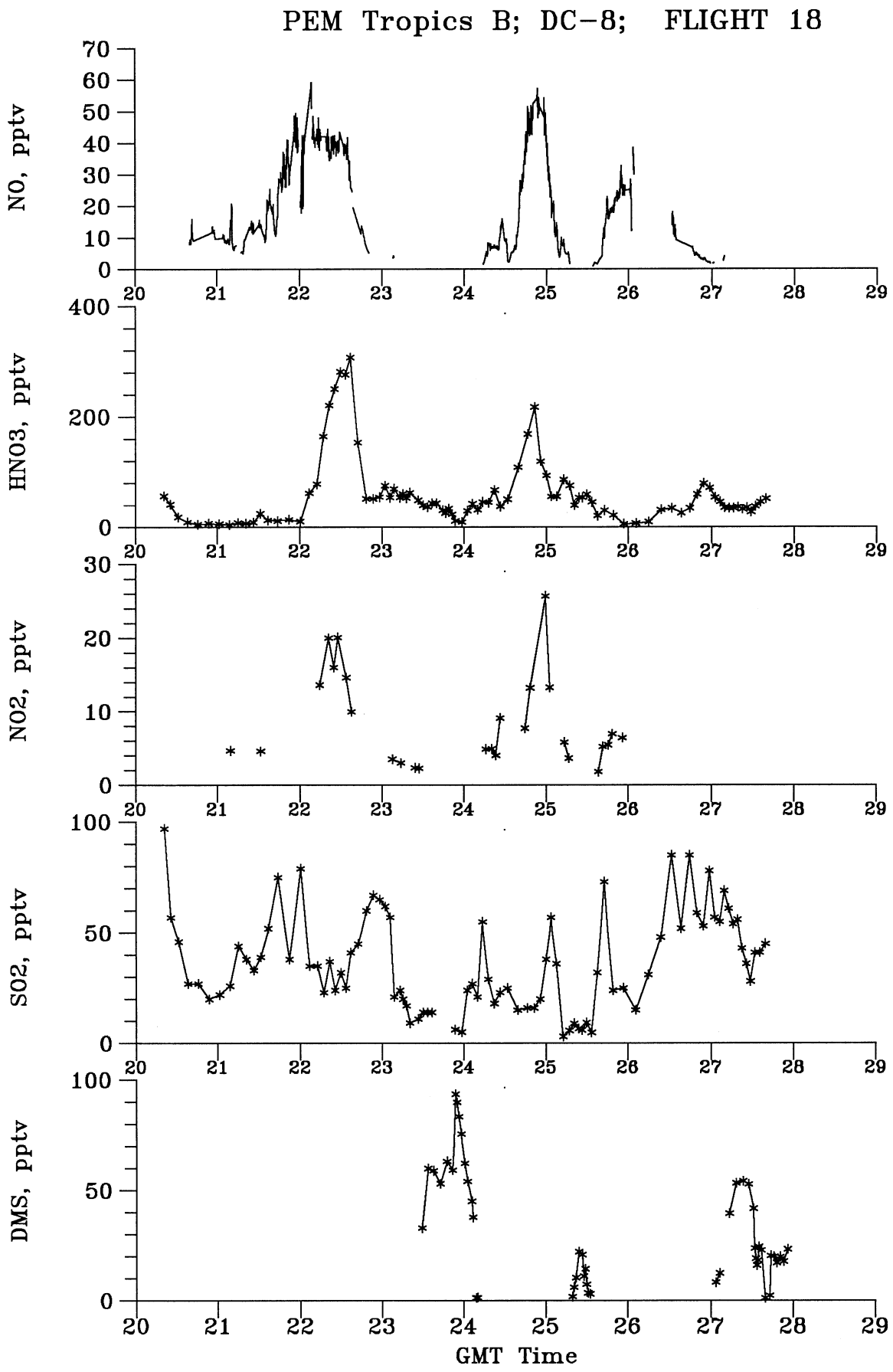
Local: Tahiti No. 5

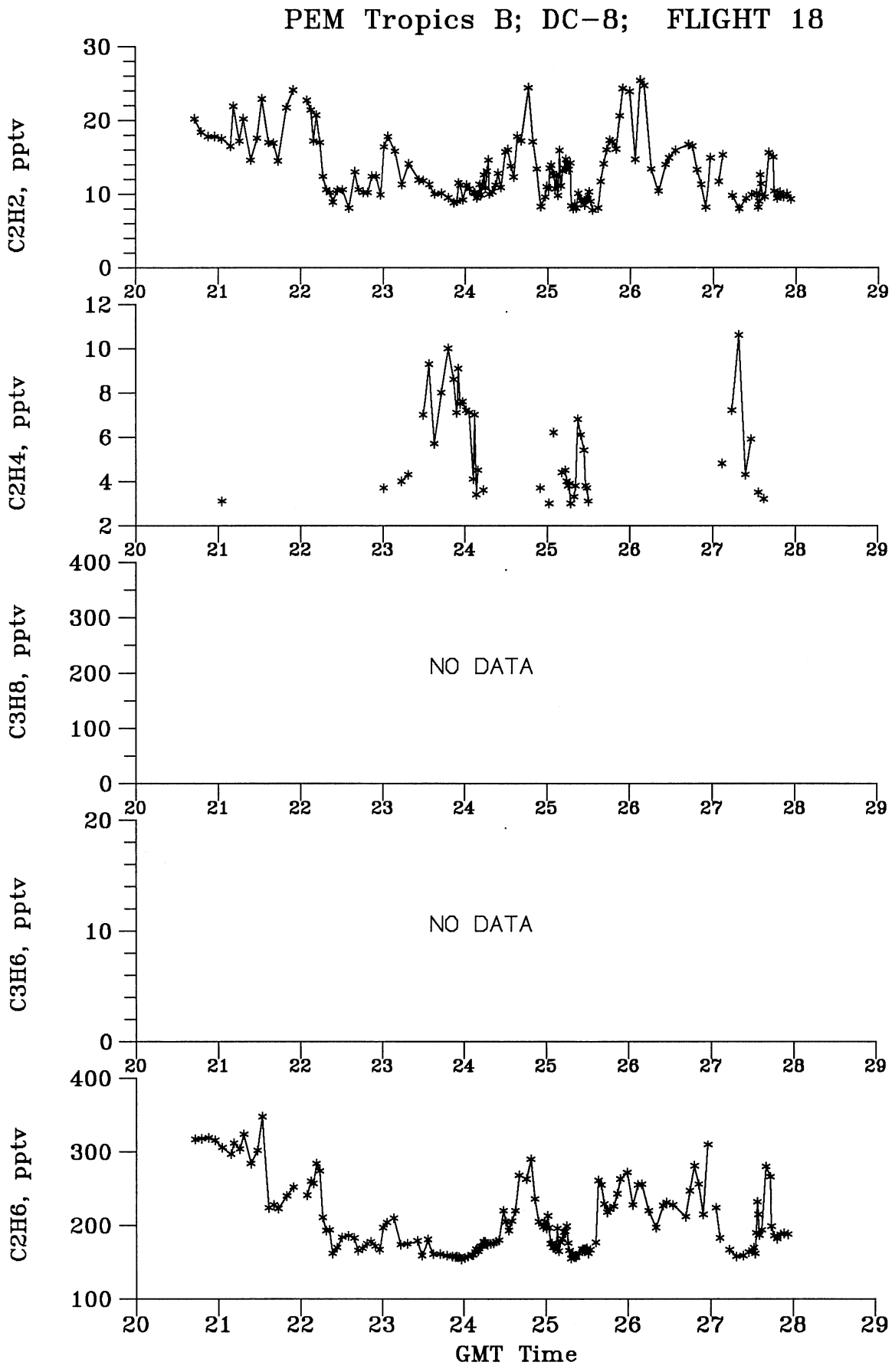
Frontal Crossing Characterization

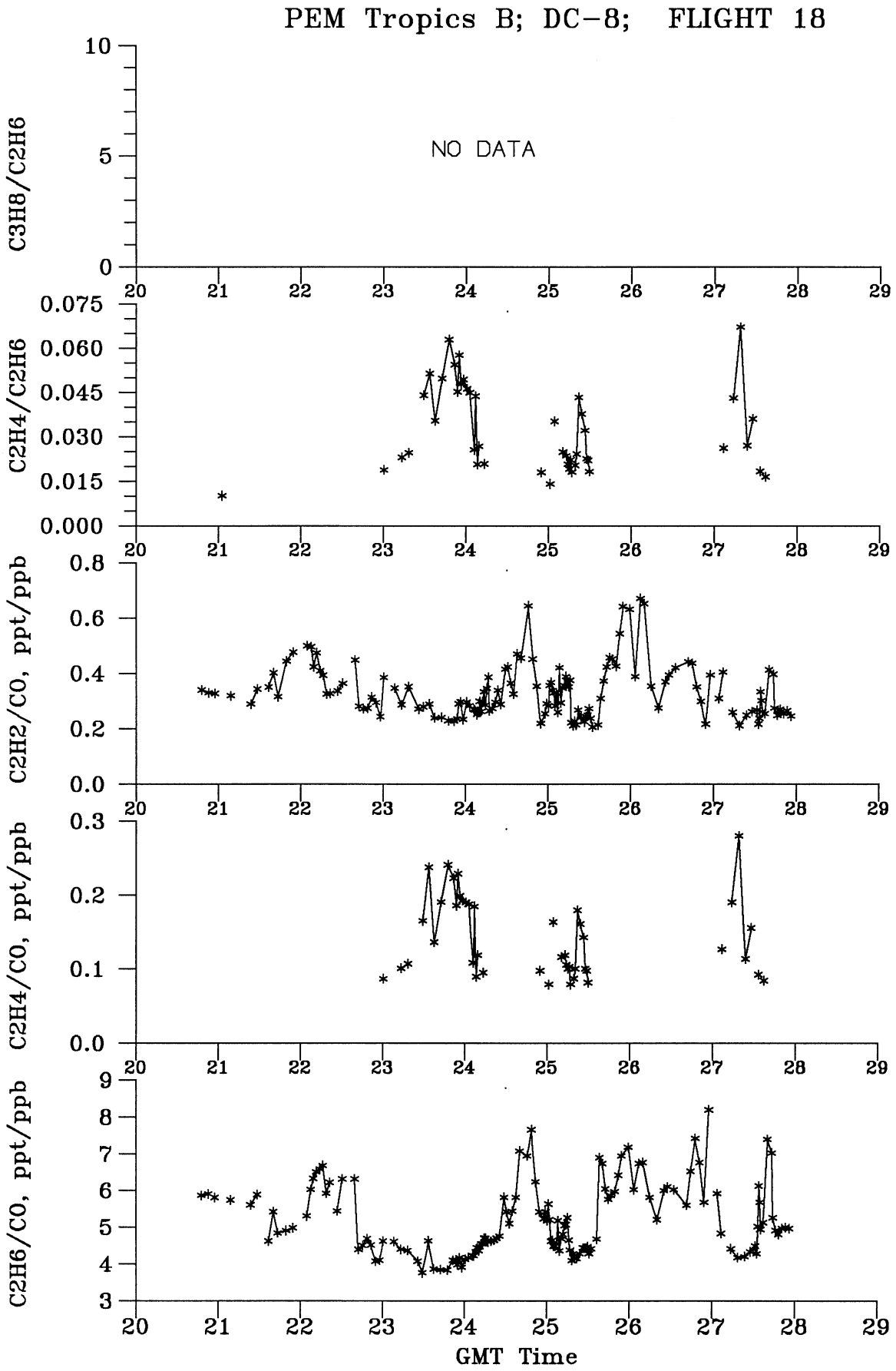
April 10, 1999

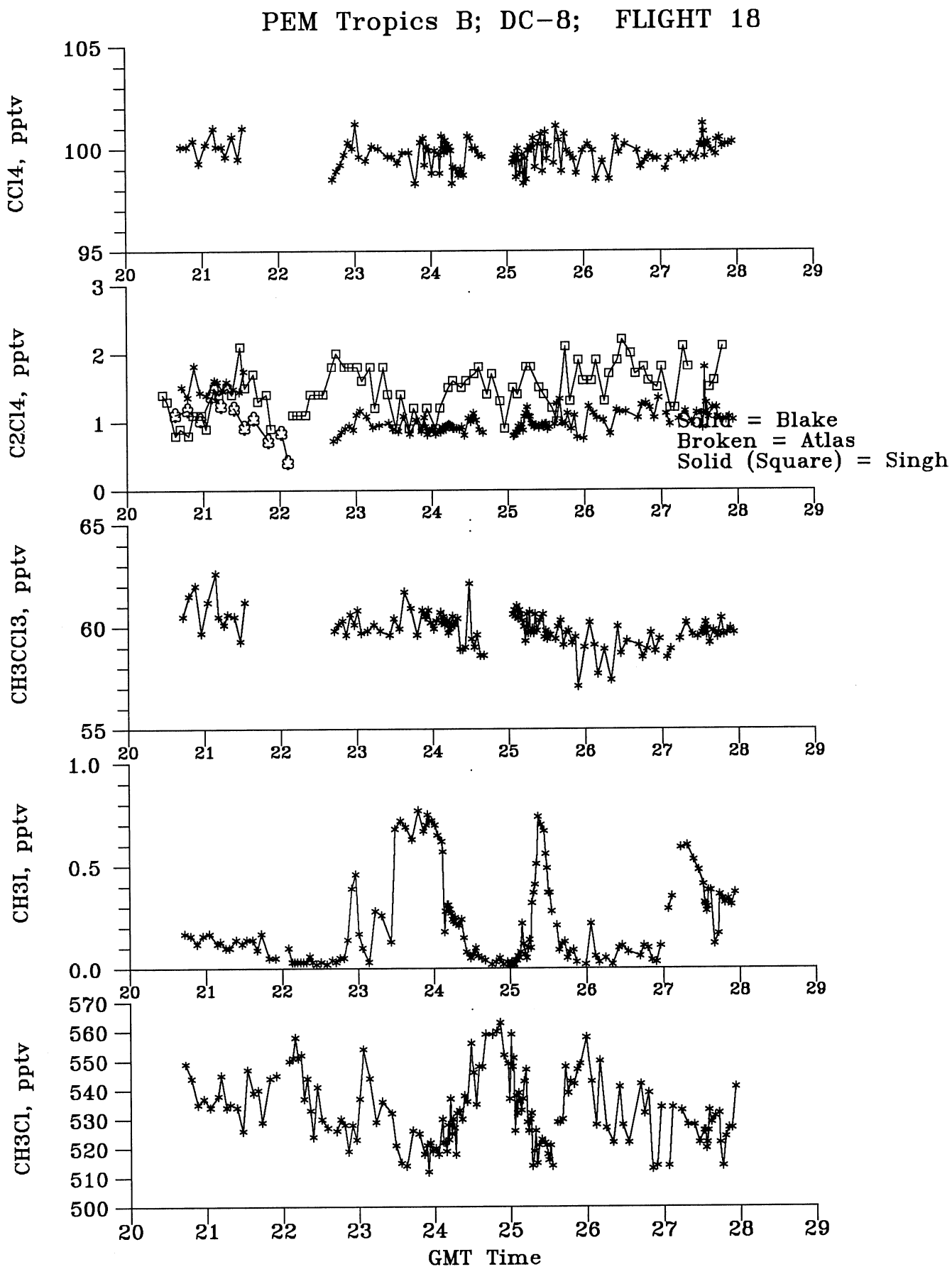

PEM Tropics B; DC-8; FLIGHT 18
North Latitude, deg.
-12
-16
-20
-24
-28
-32
-36
204
205
206
207
208
209
210
211
212
East Longitude, deg.
Altitude, km
15
10
5
0
20
21
22
23
24
25
26
27
28
29
Temperature, C
40
20
0
-20
-40
-60
-80
Solid = Static Temp
Broken = Project Dew Pt.
Rel. Hum, percent
100
50
0
Water Vapor, ppmv
20000
10000
0
GMT Time

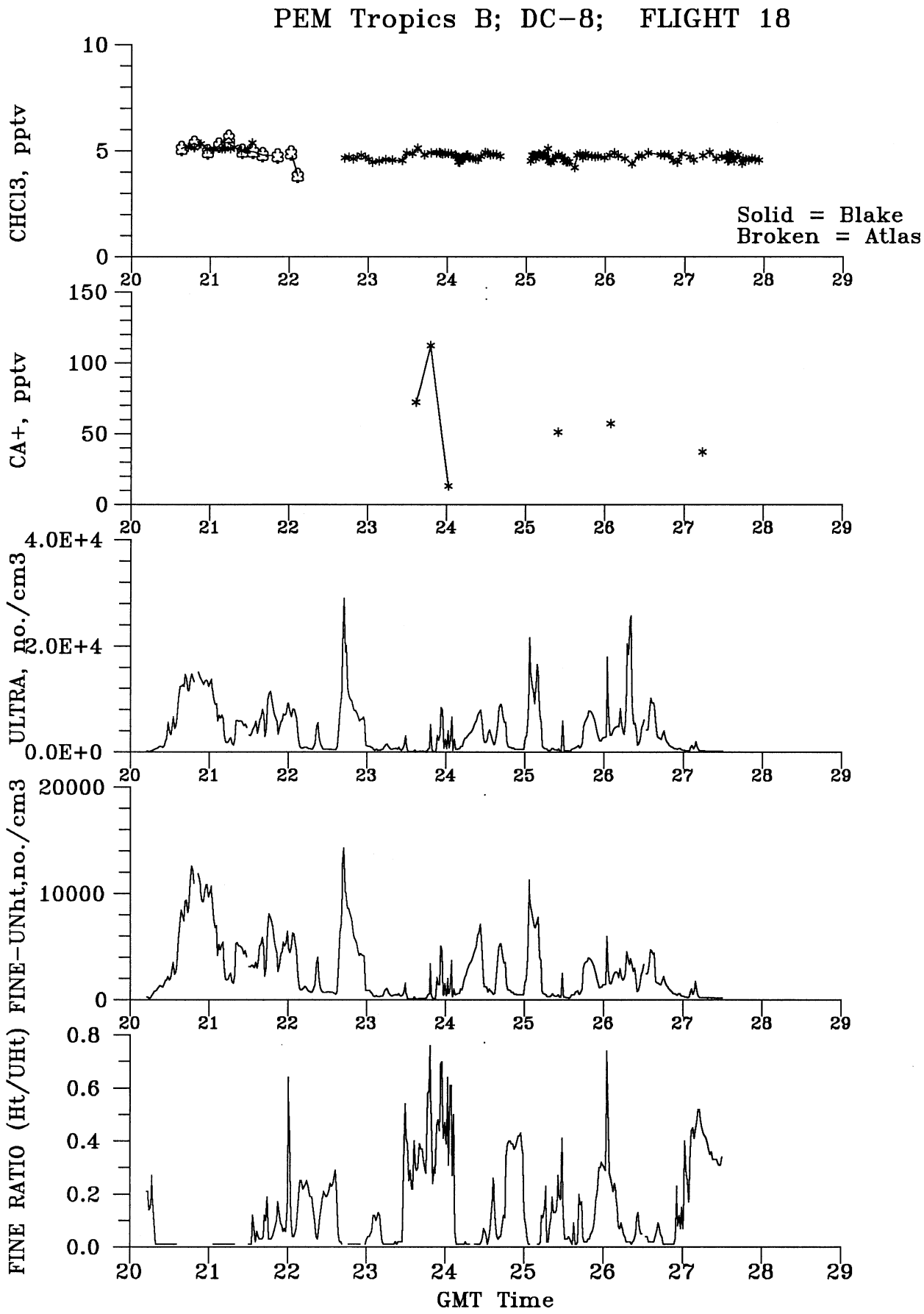

PEM Tropics B; DC-8; FLIGHT 18
O3, ppbv
140
120
100
80
60
40
20
0
CO, ppbv
60
55
50
45
40
35
30
25
CH4, ppbv
1800
1750
1700
1650
CO2, ppmv
370
365
360
OH, pptv
0.75
0.50
0.25
0.00
20
21
22
23
24
25
26
27
28
29
GMT Time

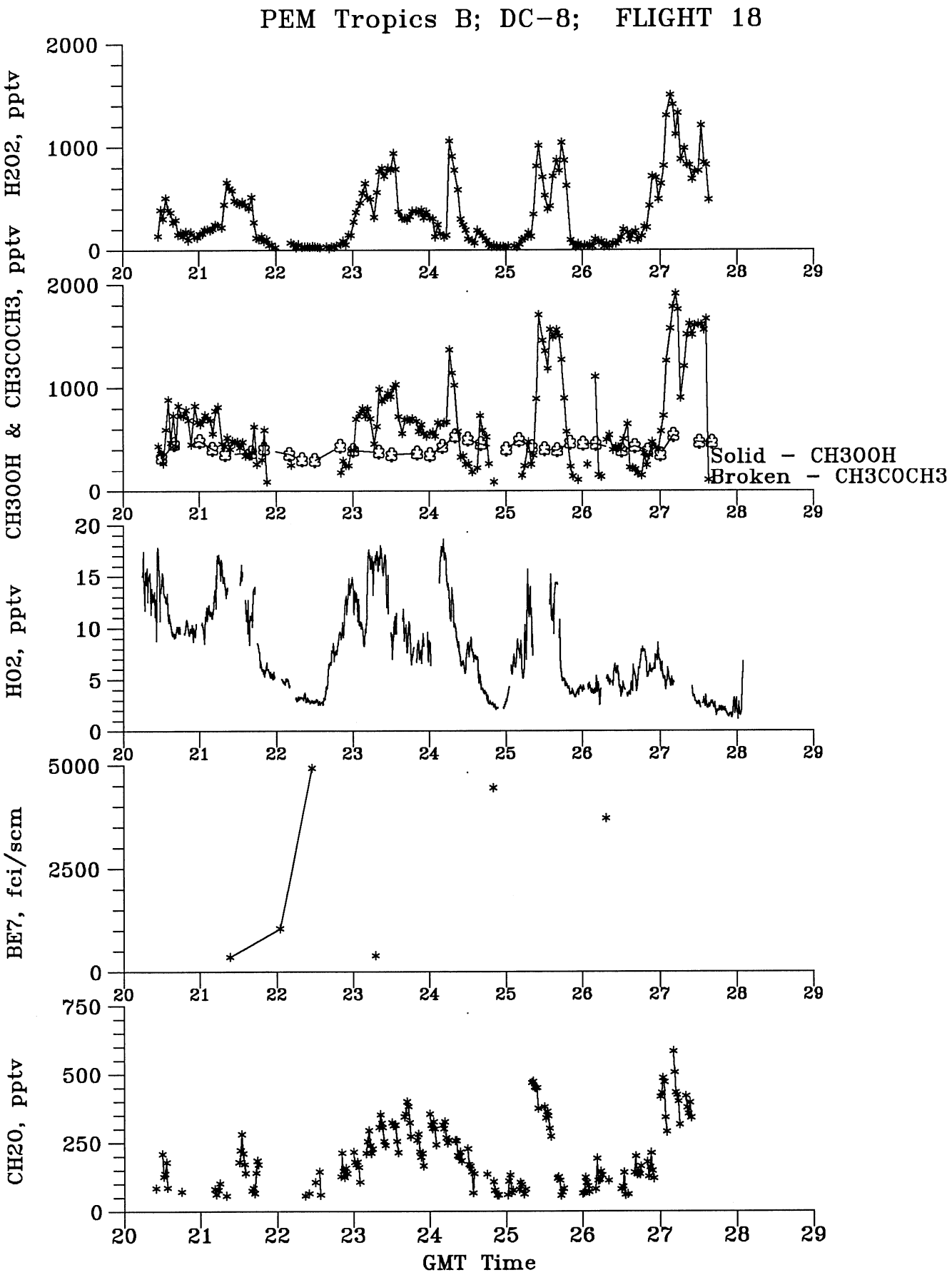

PEM Tropics B; DC-8; FLIGHT 18
NO, pptv
HNO3, pptv
NO2, pptv
SO2, pptv
DMS, pptv
GMT Time

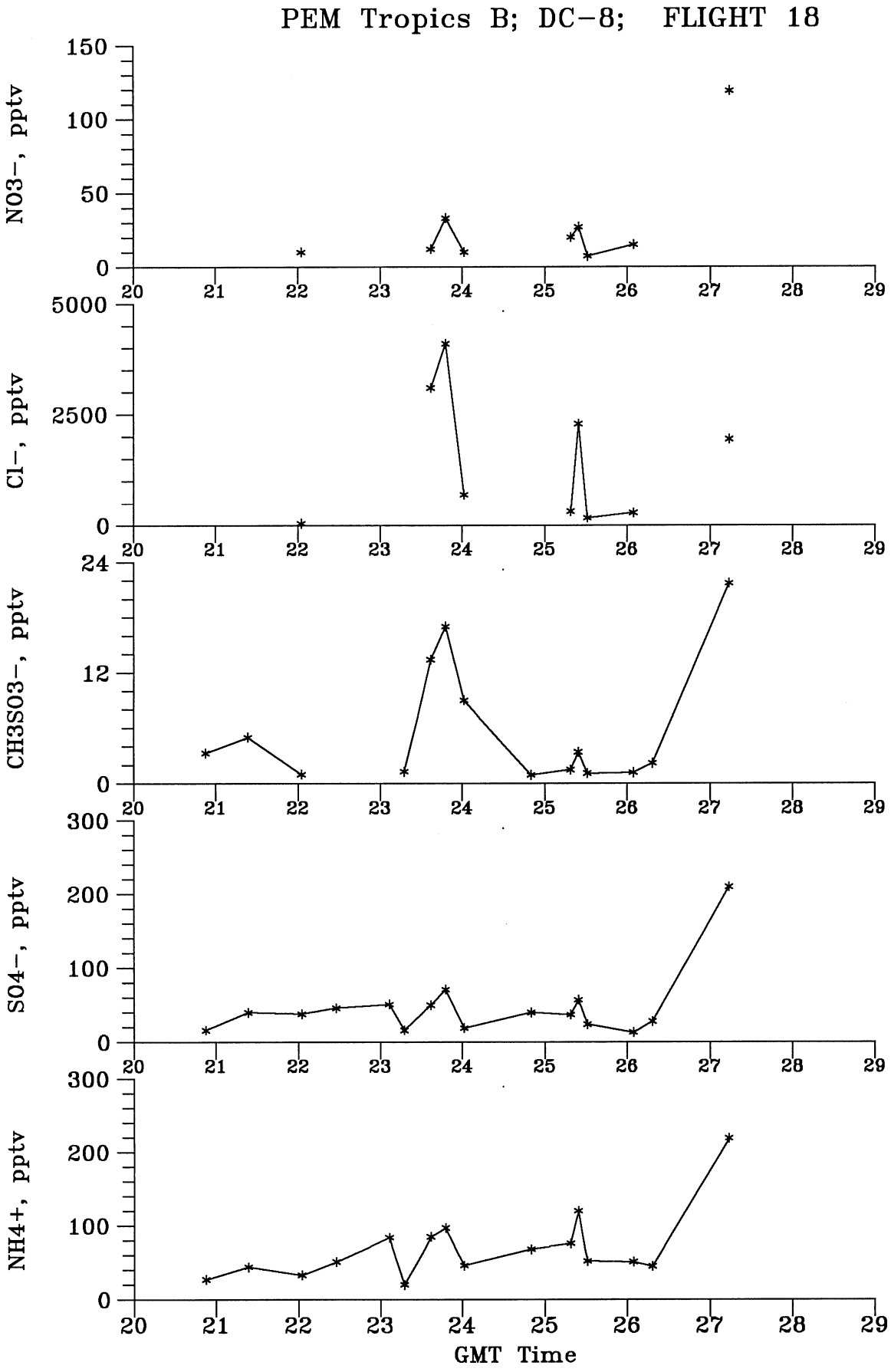

PEM Tropics B; DC-8; FLIGHT 18
C2H2, pptv
C2H4, pptv
C3H8, pptv
NO DATA
C3H6, pptv
NO DATA
C2H6, pptv
GMT Time

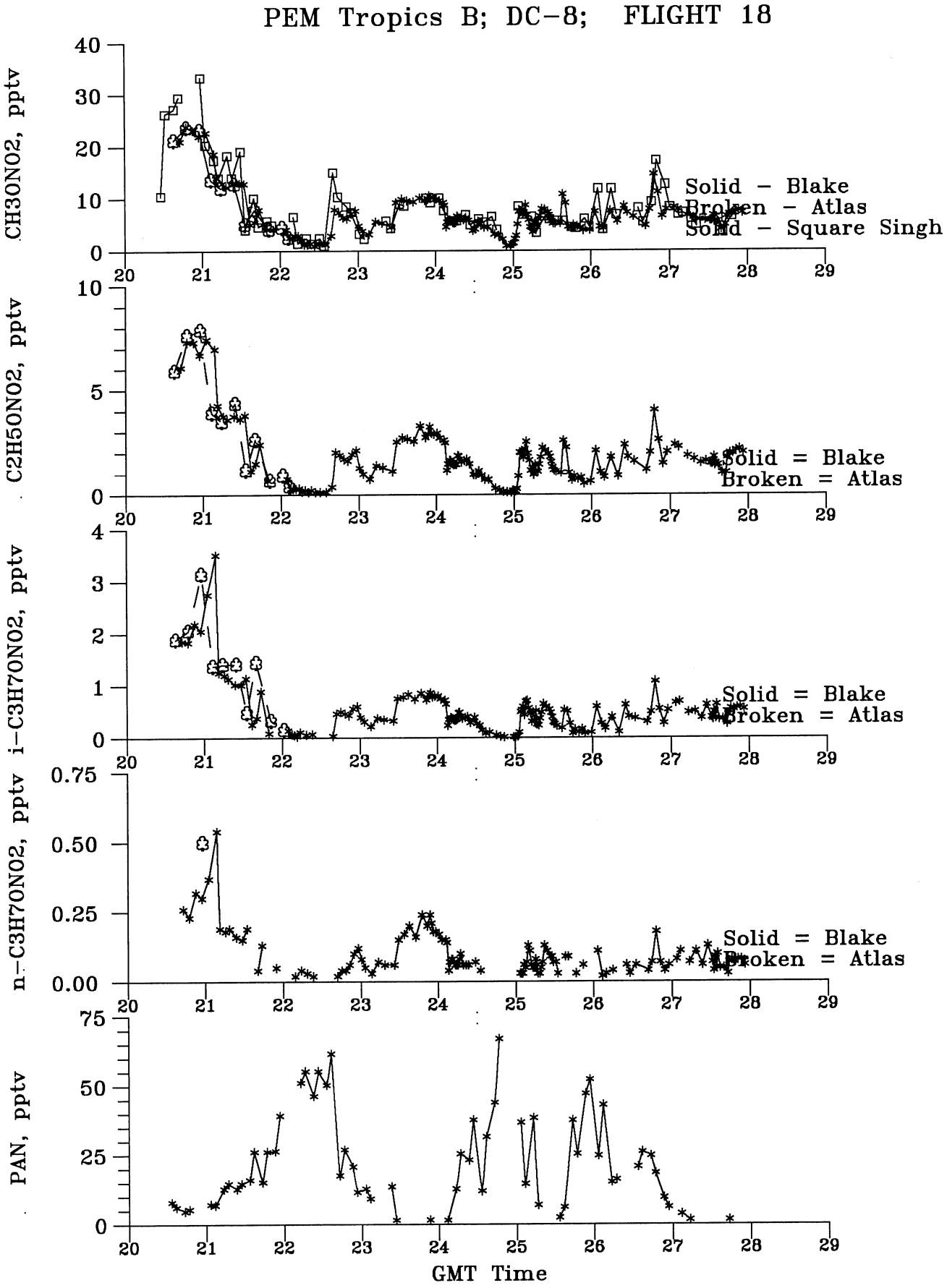

PEM Tropics B; DC-8; FLIGHT 18
C3H8/C2H6
NO DATA
C2H4/C2H6
C2H2/CO, ppt/ppb
C2H4/CO, ppt/ppb
C2H6/CO, ppt/ppb
GMT Time

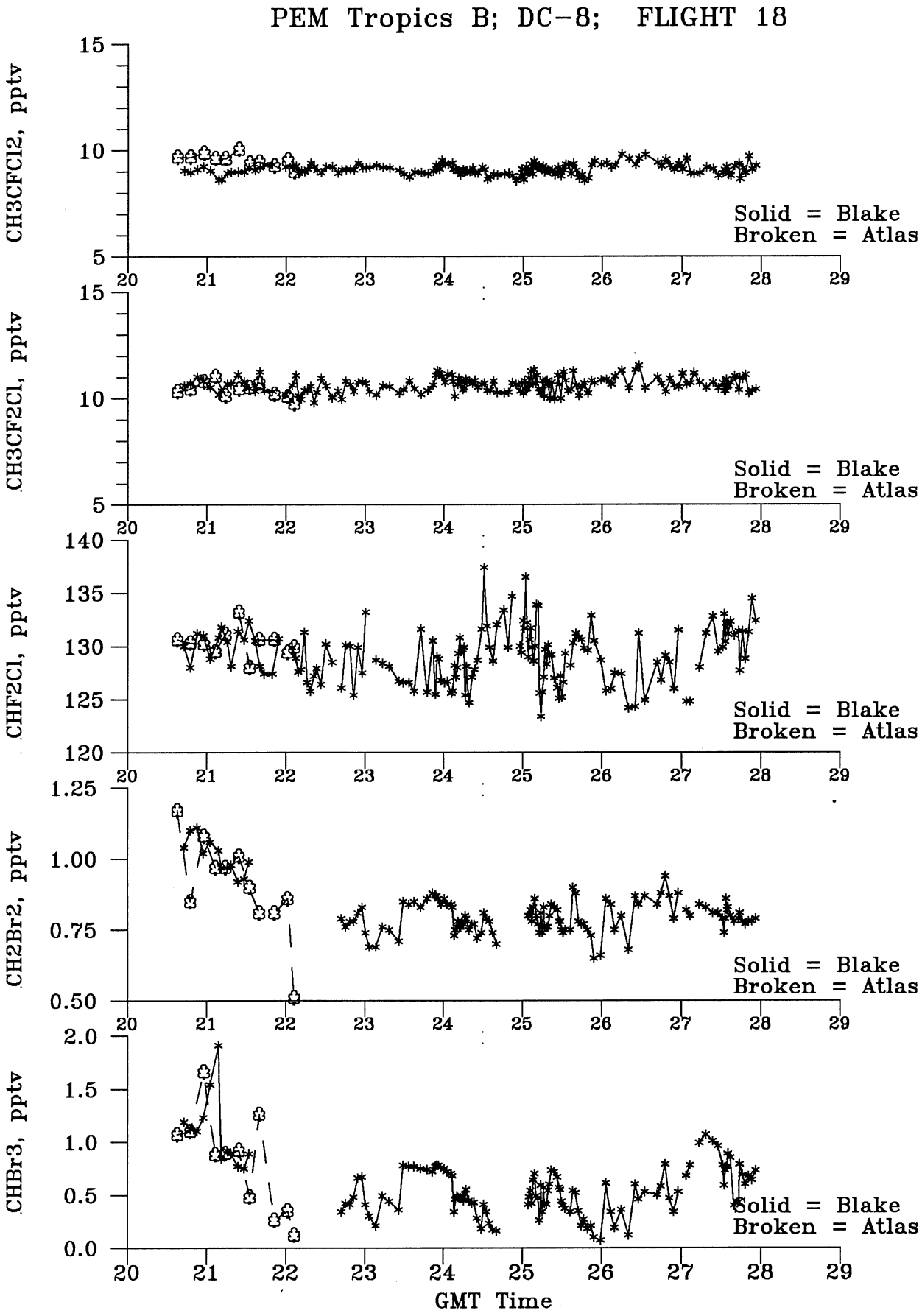

PEM Tropics B; DC-8; FLIGHT 18
CCl4, pptv
105
100
95
C2Cl4, pptv
3
2
1
0
Solid = Blake
Broken = Atlas
Solid (Square) = Singh
CH3CCl3, pptv
65
60
55
CH3I, pptv
1.0
0.5
0.0
CH3Cl, pptv
570
560
550
540
530
520
510
500
20
21
22
23
24
25
26
27
28
29
GMT Time

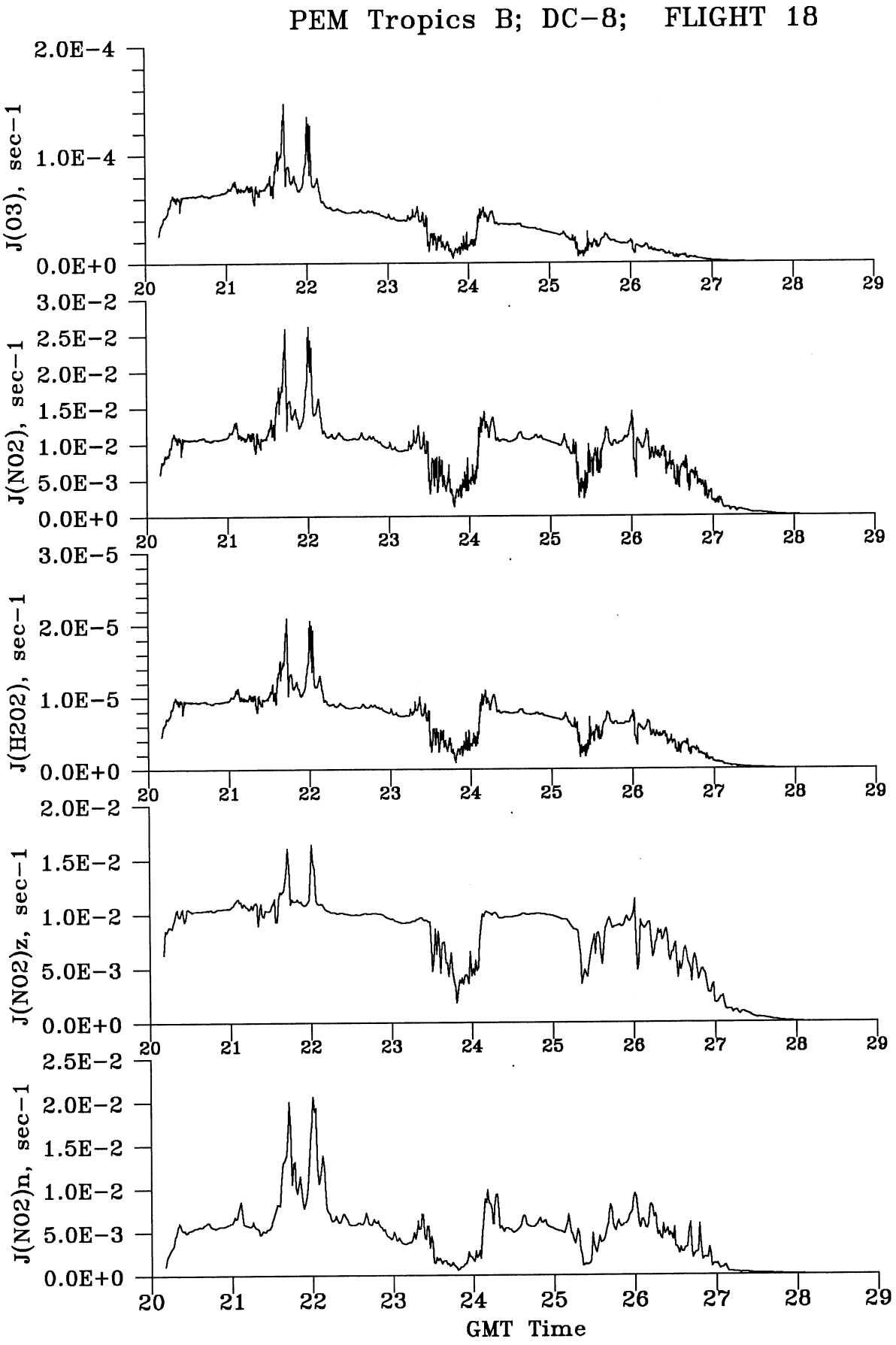

PEM Tropics B; DC-8; FLIGHT 18
CHCl3, pptv
Solid = Blake
Broken = Atlas
CA+, pptv
ULTRA, no./cm3
FINE-UNht,no./cm3
FINE RATIO (Ht/UHt)
GMT Time

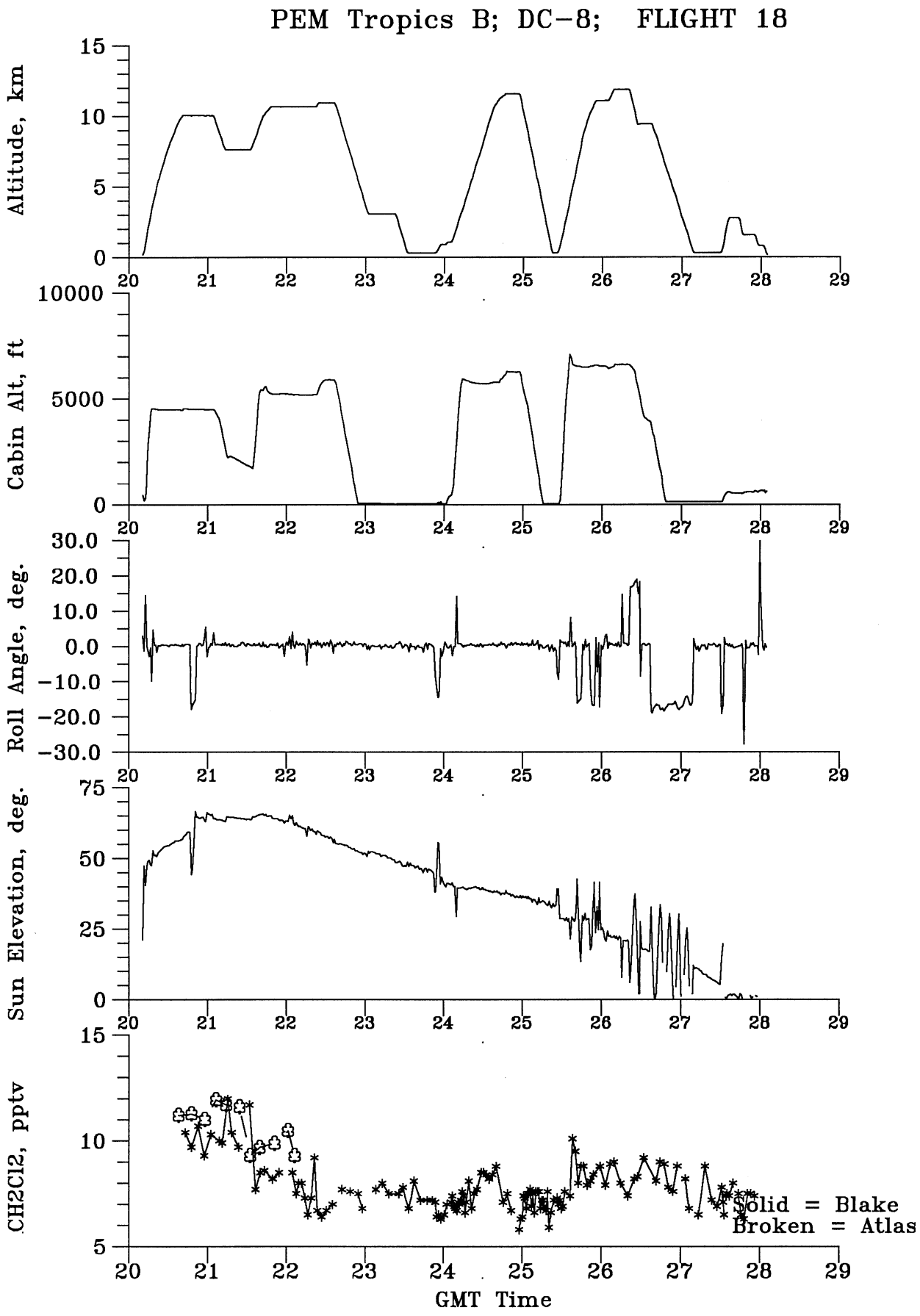

PEM Tropics B; DC-8; FLIGHT 18
H2O2, pptv
2000
1000
0
CH3OOH & CH3COCH3, pptv
2000
1000
0
Solid - CH3OOH
Broken - CH3COCH3
HO2, pptv
20
15
10
5
0
BE7, fci/scm
5000
2500
0
CH2O, pptv
750
500
250
0
20
21
22
23
24
25
26
27
28
29
GMT Time


PEM Tropics B; DC-8; FLIGHT 18
NO3-, pptv
150
100
50
0
Cl-, pptv
5000
2500
0
CH3SO3-, pptv
24
12
0
SO4-, pptv
300
200
100
0
NH4+, pptv
300
200
100
0
20
21
22
23
24
25
26
27
28
29
GMT Time

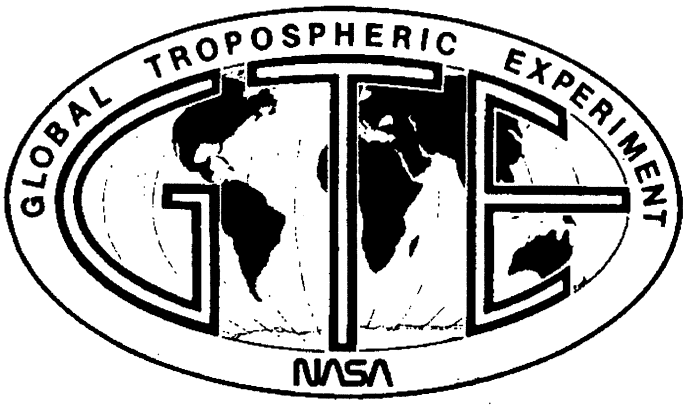

PEM Tropics B; DC-8; FLIGHT 18
CH3ONO2, pptv
Solid - Blake
Broken - Atlas
Solid - Square Singh
C2H5ONO2, pptv
Solid = Blake
Broken = Atlas
i-C3H7ONO2, pptv
Solid = Blake
Broken = Atlas
n-C3H7ONO2, pptv
Solid = Blake
Broken = Atlas
PAN, pptv
GMT Time


PEM Tropics B; DC-8; FLIGHT 18
CH3CFCl2, pptv
15
10
5
Solid = Blake
Broken = Atlas
CH3CF2Cl, pptv
15
10
5
Solid = Blake
Broken = Atlas
CHF2Cl, pptv
140
135
130
125
120
Solid = Blake
Broken = Atlas
CH2Br2, pptv
1.25
1.00
0.75
0.50
Solid = Blake
Broken = Atlas
CHBr3, pptv
2.0
1.5
1.0
0.5
0.0
Solid = Blake
Broken = Atlas
20
21
22
23
24
25
26
27
28
29
GMT Time


PEM Tropics B; DC-8; FLIGHT 18
J(O3), sec-1
2.0E-4
1.0E-4
0.0E+0
J(NO2), sec-1
3.0E-2
2.5E-2
2.0E-2
1.5E-2
1.0E-2
5.0E-3
0.0E+0
J(H2O2), sec-1
3.0E-5
2.0E-5
1.0E-5
0.0E+0
J(NO2)z, sec-1
2.0E-2
1.5E-2
1.0E-2
5.0E-3
0.0E+0
J(NO2)n, sec-1
2.5E-2
2.0E-2
1.5E-2
1.0E-2
5.0E-3
0.0E+0
20 21 22 23 24 25 26 27 28 29
GMT Time


PEM Tropics B; DC-8; FLIGHT 18
Altitude, km
15
10
5
0
Cabin Alt, ft
10000
5000
0
Roll Angle, deg.
30.0
20.0
10.0
0.0
-10.0
-20.0
-30.0
Sun Elevation, deg.
75
50
25
0
CH2Cl2, pptv
15
10
5
20
21
22
23
24
25
26
27
28
29
GMT Time
Solid = Blake
Broken = Atlas

PLOTS OF FINAL CHEMICAL DATA



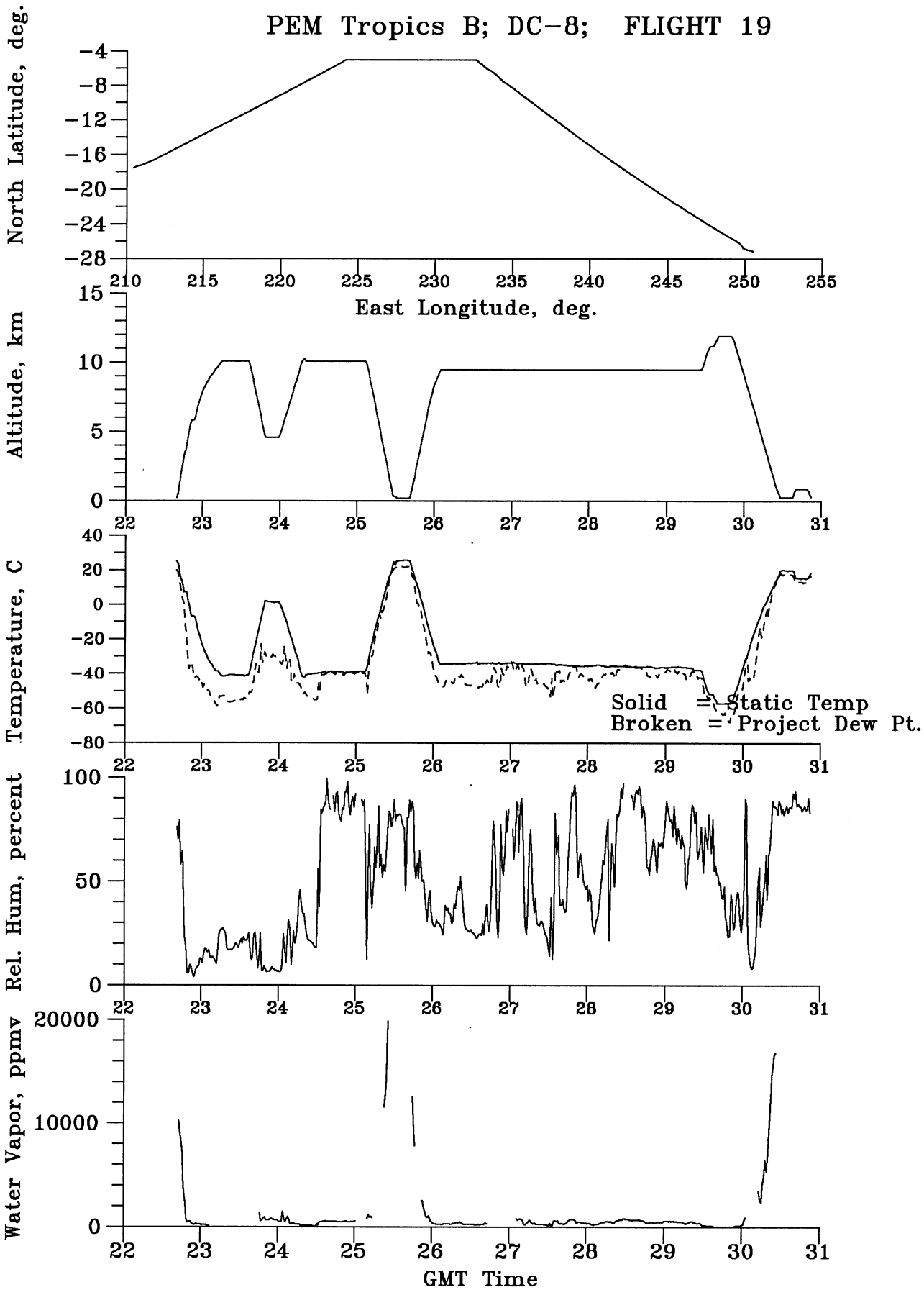
PEM-TROPICS B

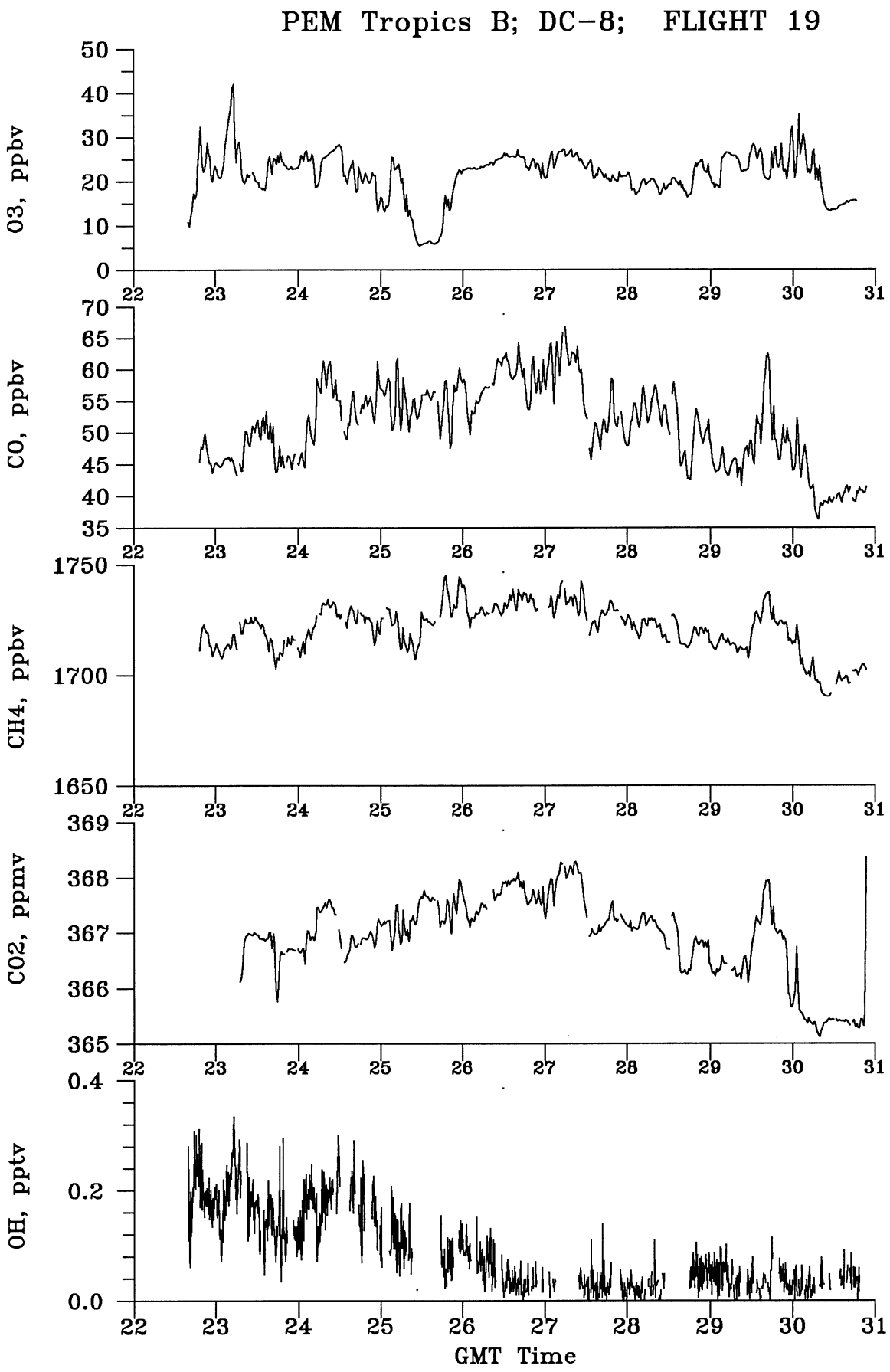
Flight 19D

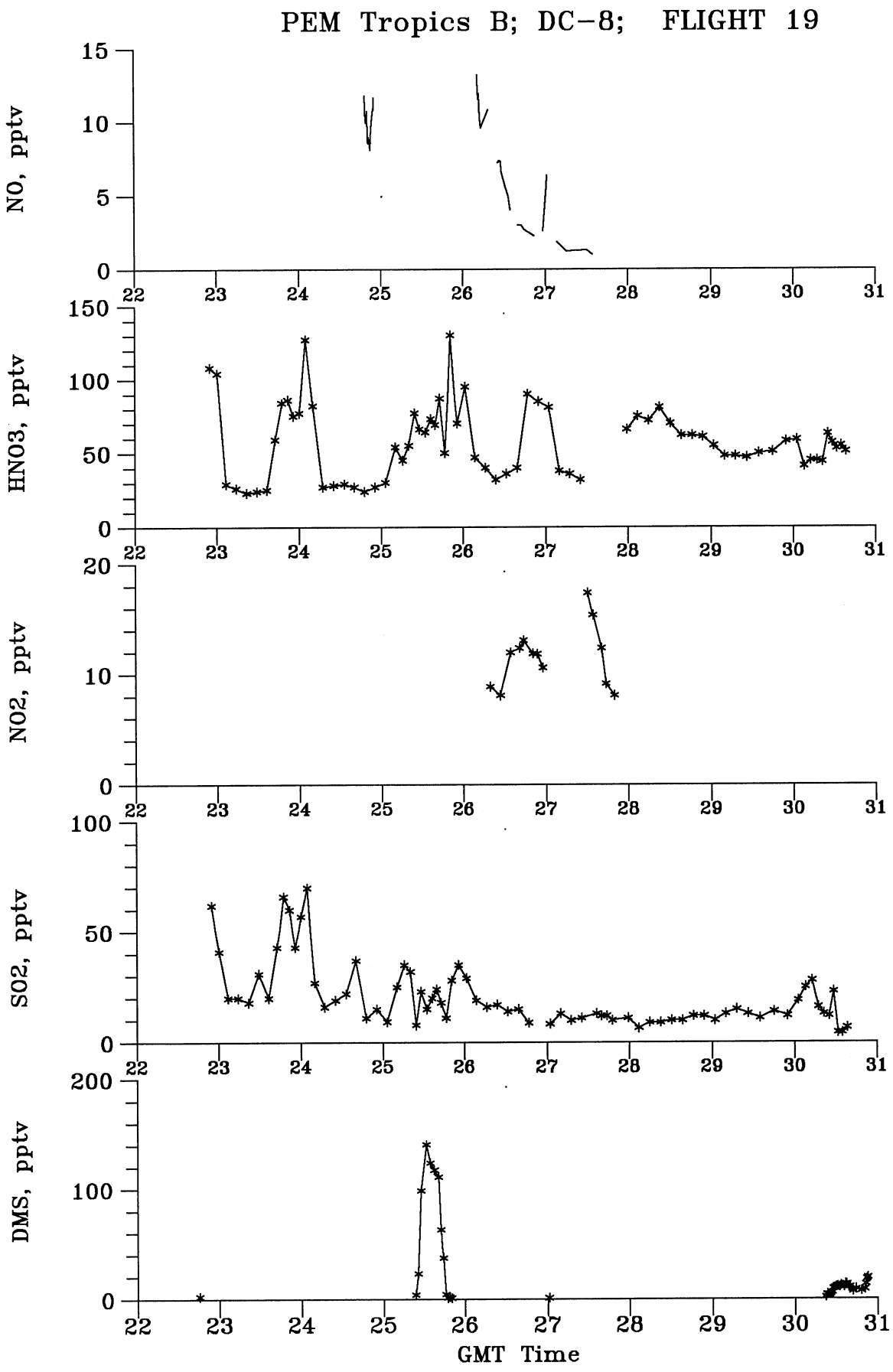
Transit: Tahiti to Easter Island

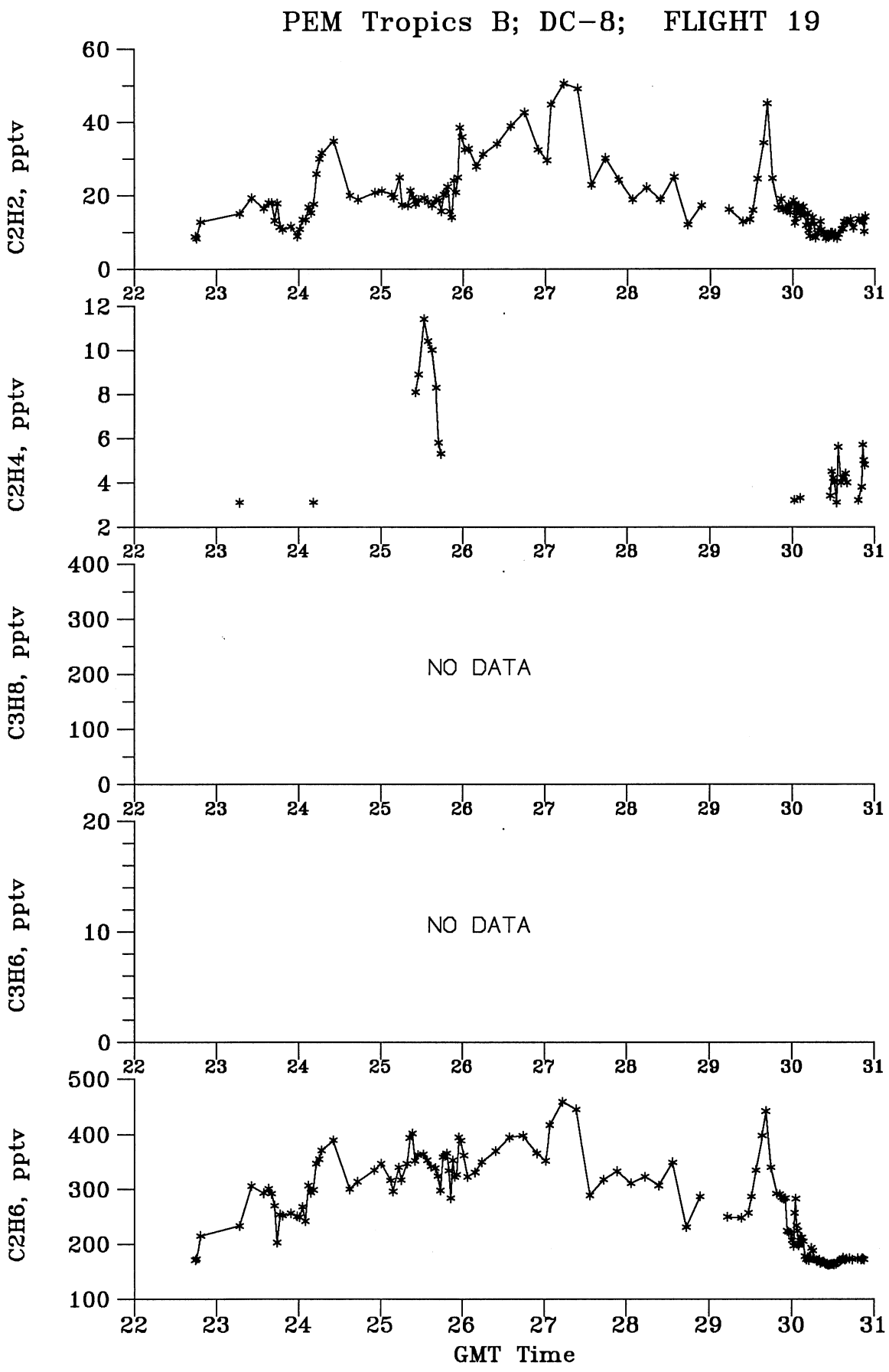
Tropical Convective Outflow

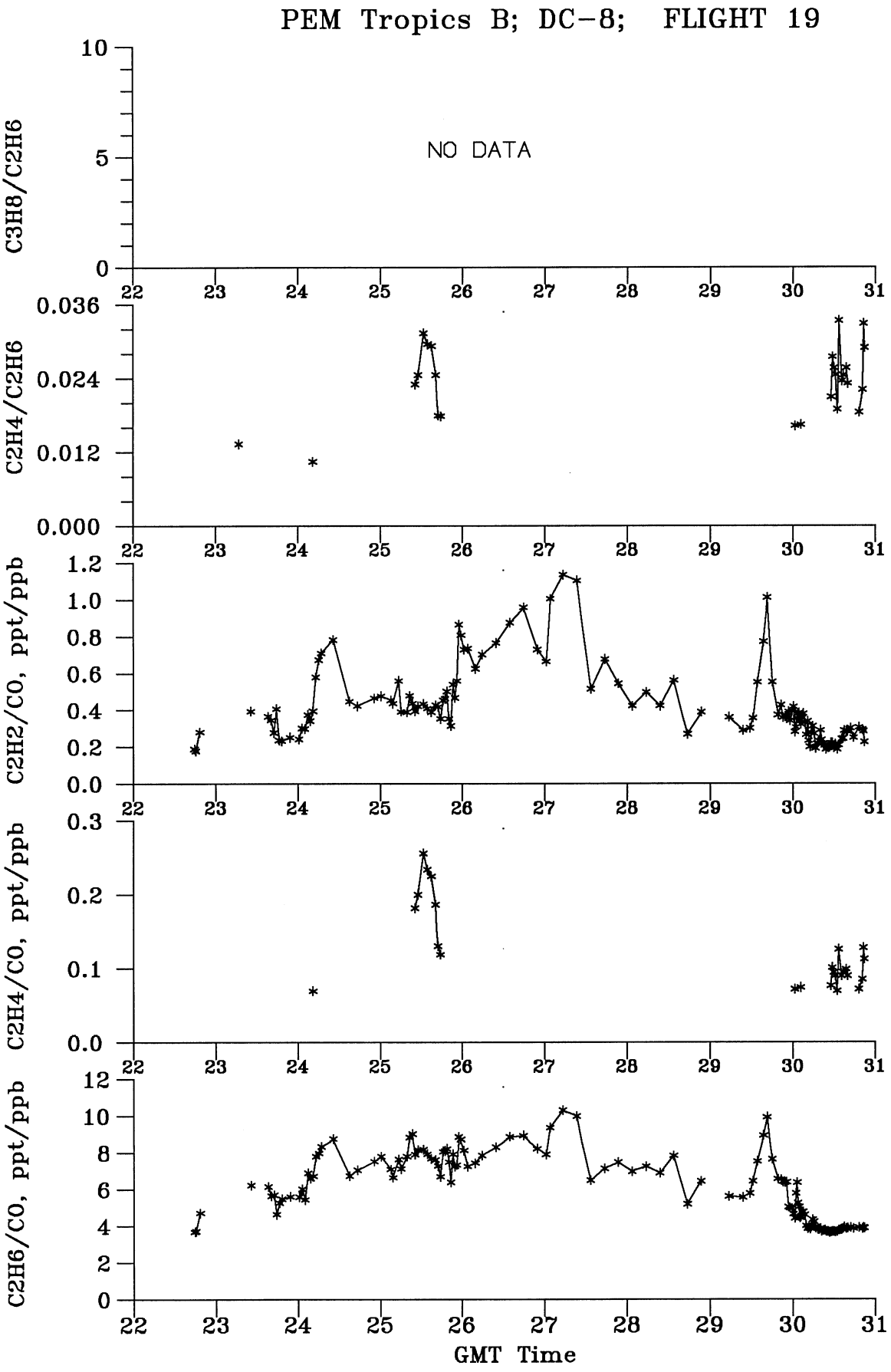
April 13, 1999

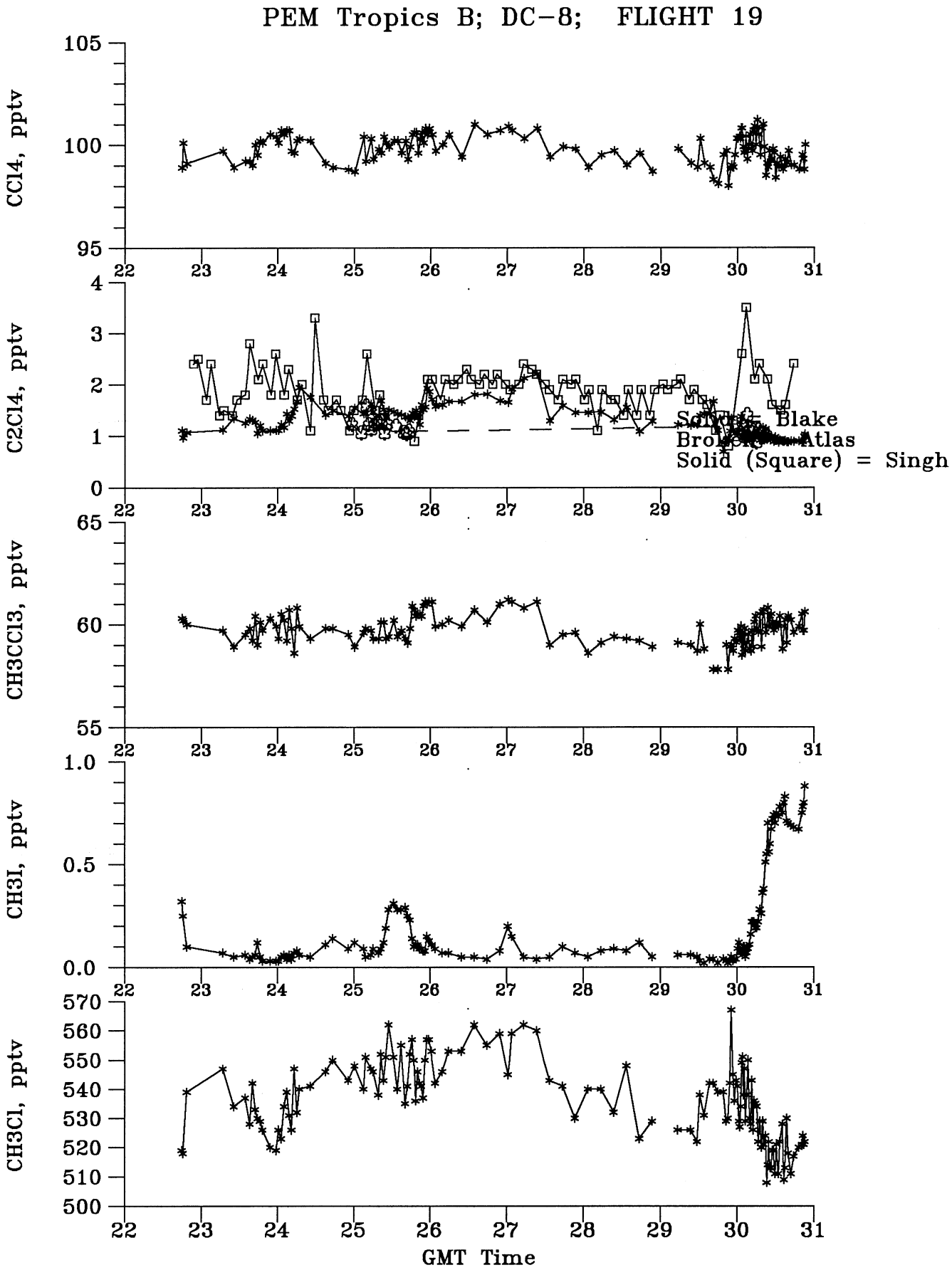

PEM Tropics B; DC-8; FLIGHT 19
North Latitude, deg.
-4
-8
-12
-16
-20
-24
-28
210
215
220
225
230
235
240
245
250
255
East Longitude, deg.
Altitude, km
15
10
5
0
22
23
24
25
26
27
28
29
30
31
Temperature, C
40
20
0
-20
-40
-60
-80
Solid = Static Temp
Broken = Project Dew Pt.
Rel. Hum, percent
100
50
0
Water Vapor, ppmv
20000
10000
0
GMT Time

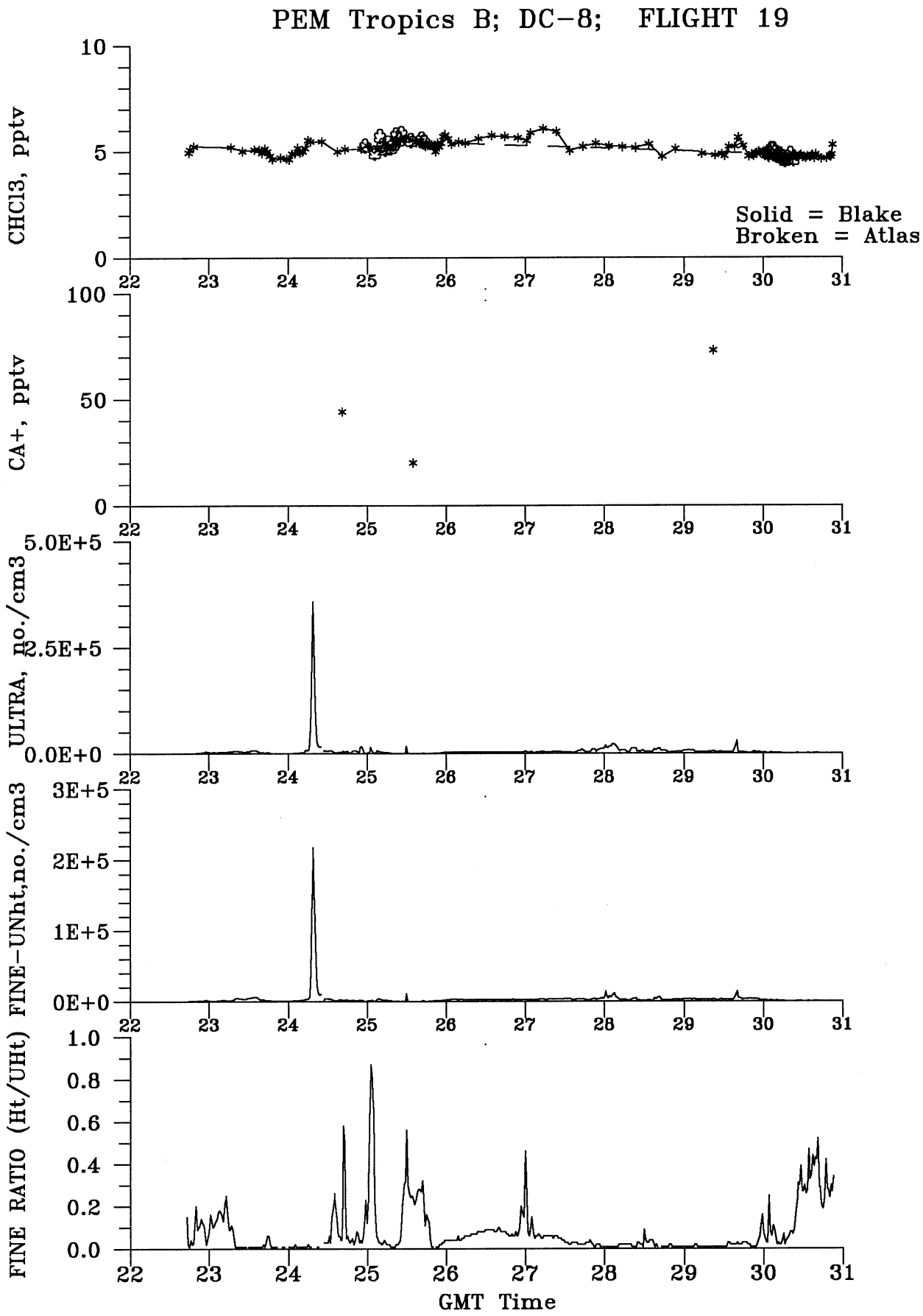

PEM Tropics B; DC-8; FLIGHT 19
O3, ppbv
50
40
30
20
10
0
CO, ppbv
70
65
60
55
50
45
40
35
CH4, ppbv
1750
1700
1650
CO2, ppmv
369
368
367
366
365
OH, pptv
0.4
0.2
0.0
22
23
24
25
26
27
28
29
30
31
GMT Time

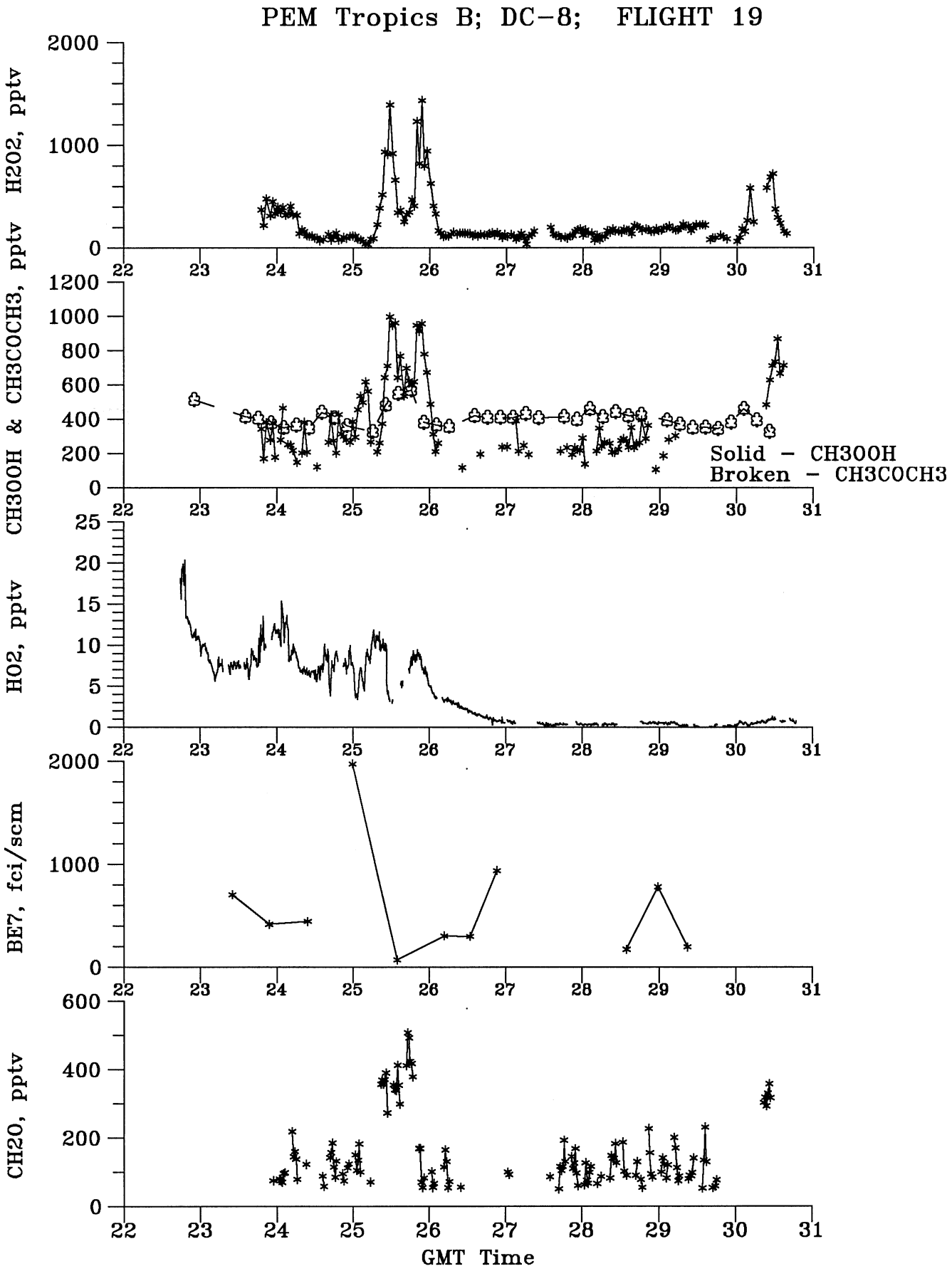

PEM Tropics B; DC-8; FLIGHT 19
NO, pptv
HNO3, pptv
NO2, pptv
SO2, pptv
DMS, pptv
GMT Time
22
23
24
25
26
27
28
29
30
31

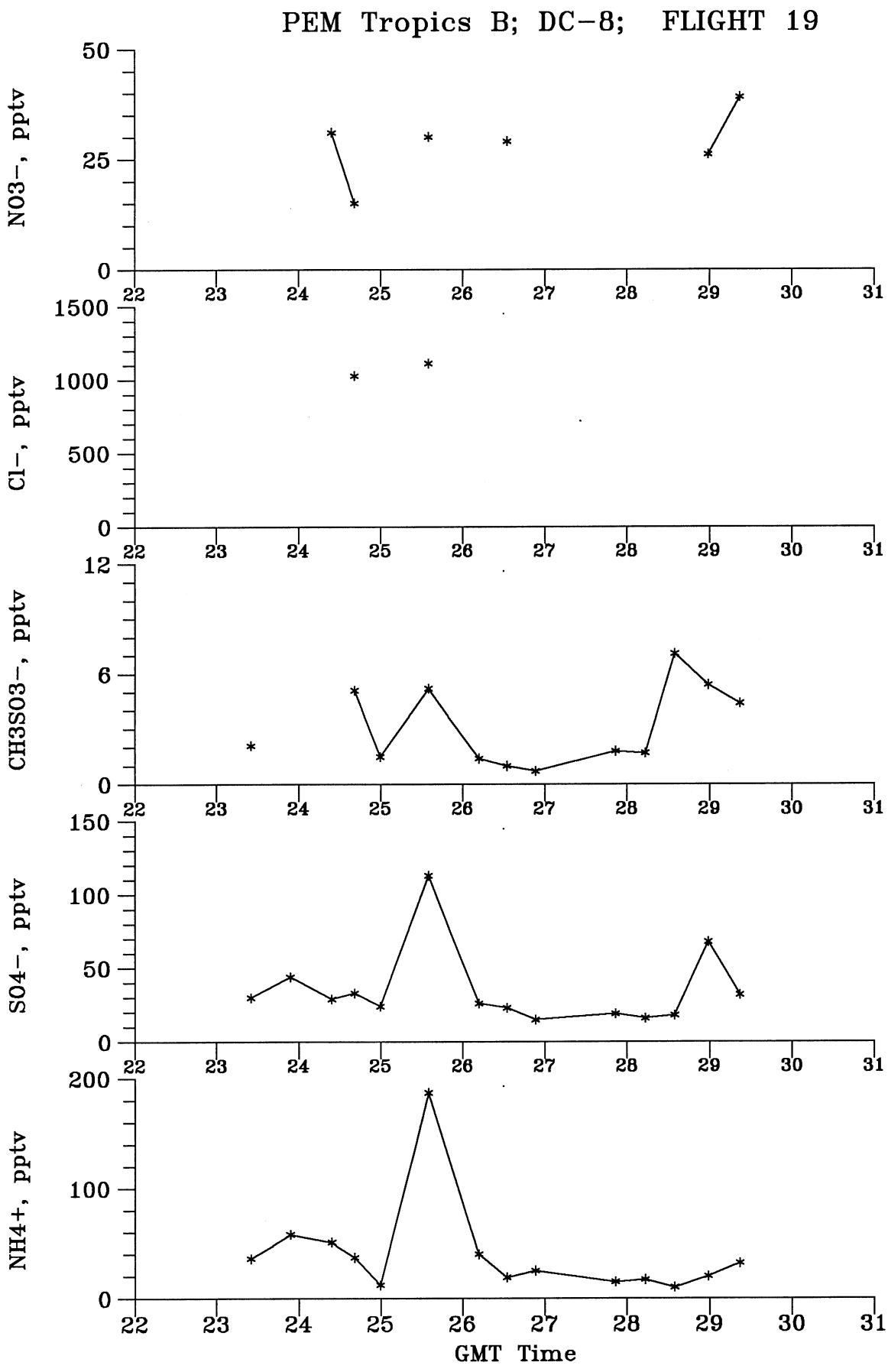

PEM Tropics B; DC-8; FLIGHT 19
C2H2, pptv
C2H4, pptv
C3H8, pptv
NO DATA
C3H6, pptv
NO DATA
C2H6, pptv
GMT Time

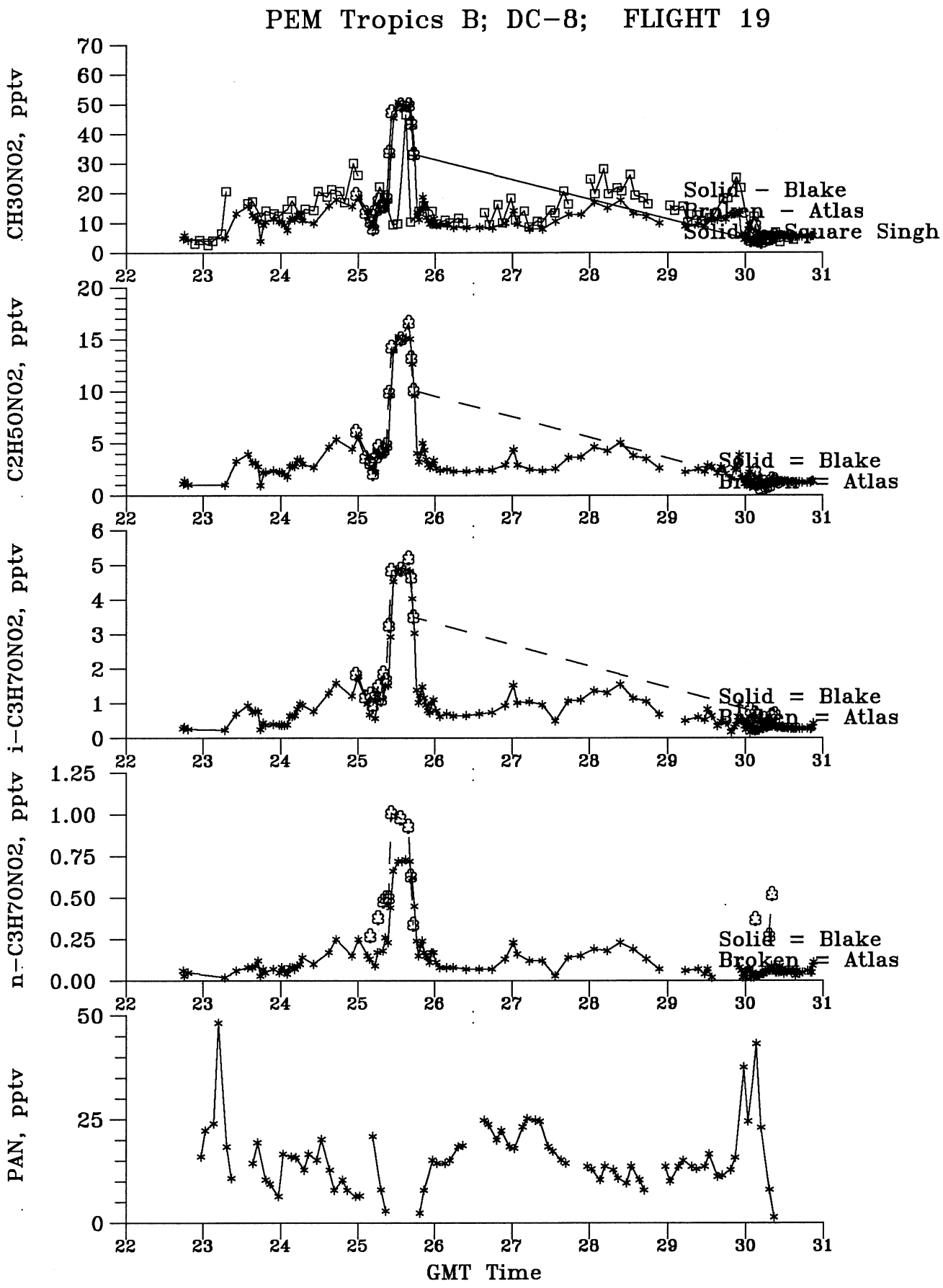

PEM Tropics B; DC-8; FLIGHT 19
NO DATA
C3H8/C2H6
C2H4/C2H6
C2H2/CO, ppt/ppb
C2H4/CO, ppt/ppb
C2H6/CO, ppt/ppb
GMT Time

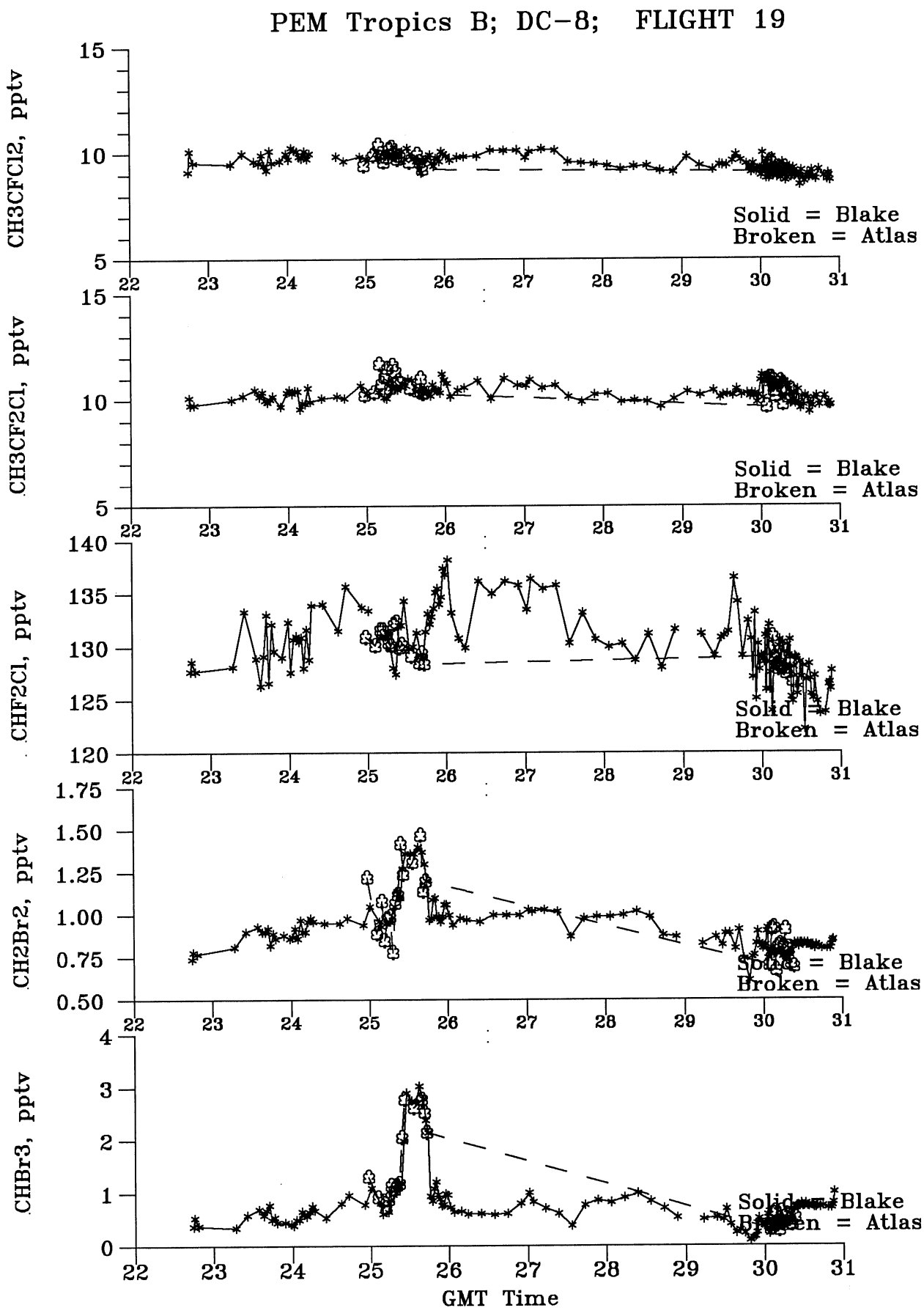

PEM Tropics B; DC-8; FLIGHT 19
CCl4, pptv
105
100
95
C2Cl4, pptv
4
3
2
1
0
Solid (Square) = Singh
CH3CCl3, pptv
65
60
55
CH3I, pptv
1.0
0.5
0.0
CH3Cl, pptv
570
560
550
540
530
520
510
500
22
23
24
25
26
27
28
29
30
31
GMT Time

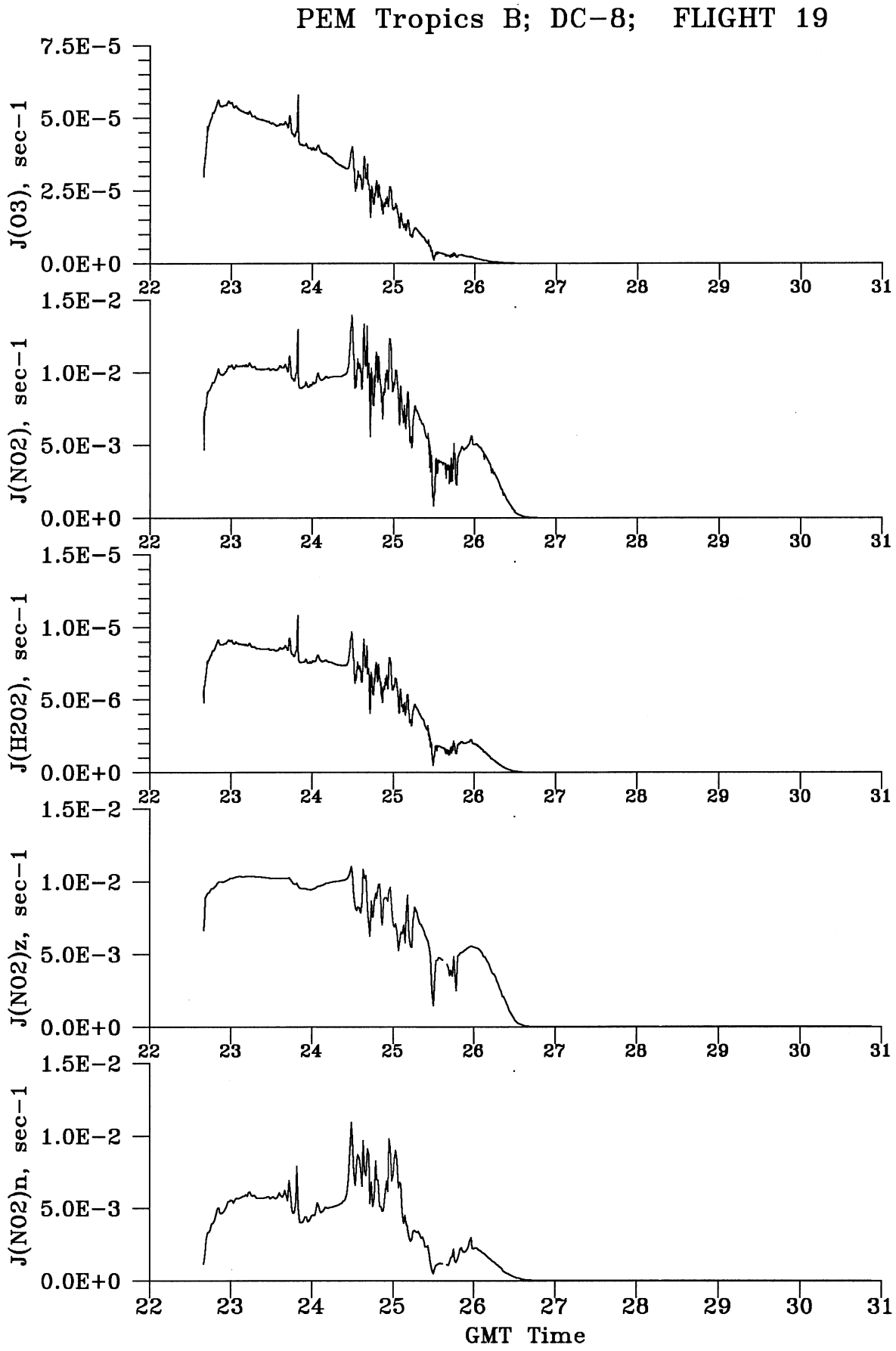

PEM Tropics B; DC-8; FLIGHT 19
CHCl3, pptv
Solid = Blake
Broken = Atlas
CA+, pptv
ULTRA, no./cm3
FINE-UNht,no./cm3
FINE RATIO (Ht/UHt)
GMT Time

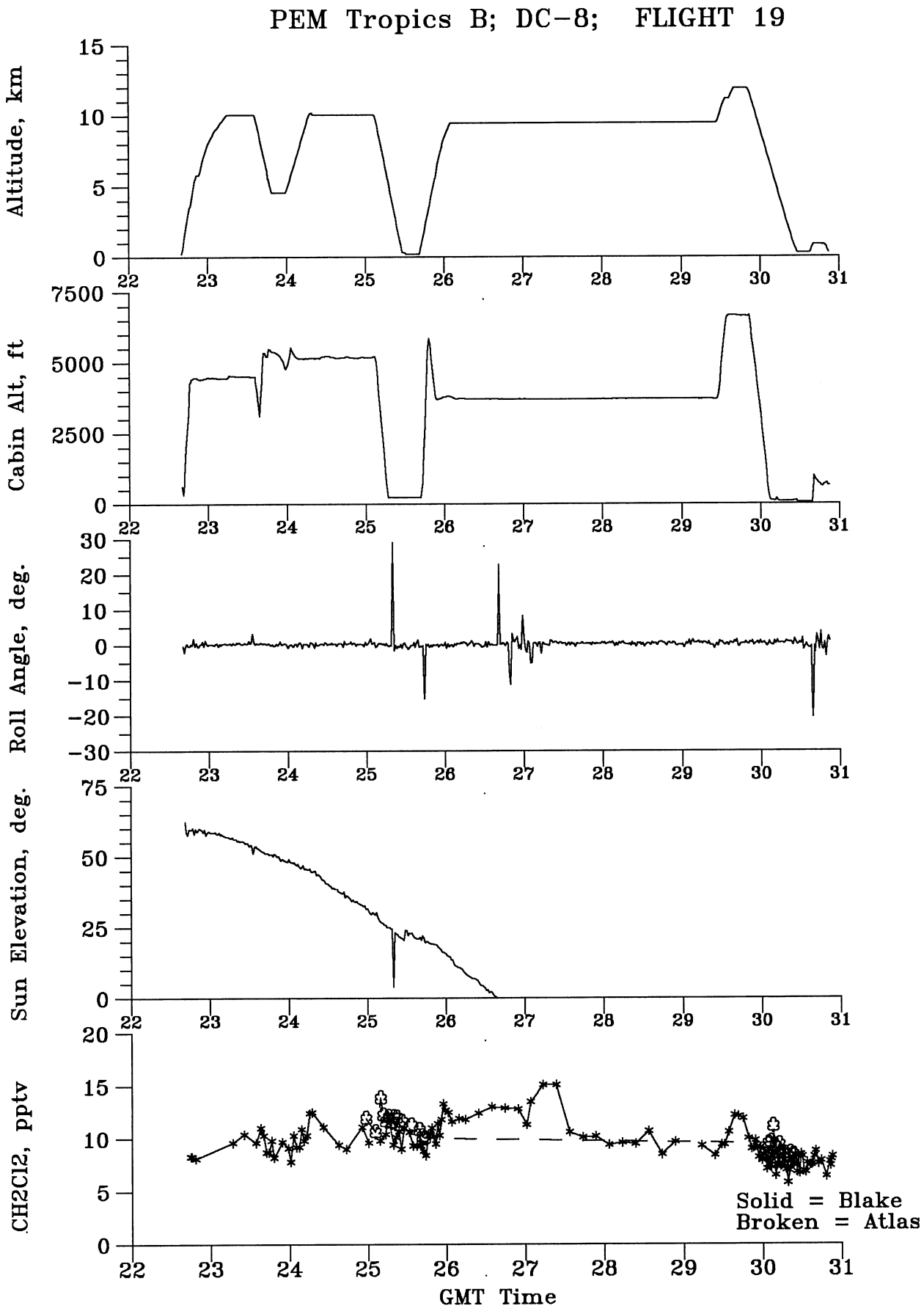

PEM Tropics B; DC-8; FLIGHT 19
H2O2, pptv
2000
1000
0
CH3OOH & CH3COCH3, pptv
1200
1000
800
600
400
200
0
Solid - CH3OOH
Broken - CH3COCH3
HO2, pptv
25
20
15
10
5
0
BE7, fci/scm
2000
1000
0
CH2O, pptv
600
400
200
0
22
23
24
25
26
27
28
29
30
31
GMT Time


PEM Tropics B; DC-8; FLIGHT 19
NO3-, pptv
50
25
0
Cl-, pptv
1500
1000
500
0
CH3SO3-, pptv
12
6
0
SO4-, pptv
150
100
50
0
NH4+, pptv
200
100
0
22
23
24
25
26
27
28
29
30
31
GMT Time

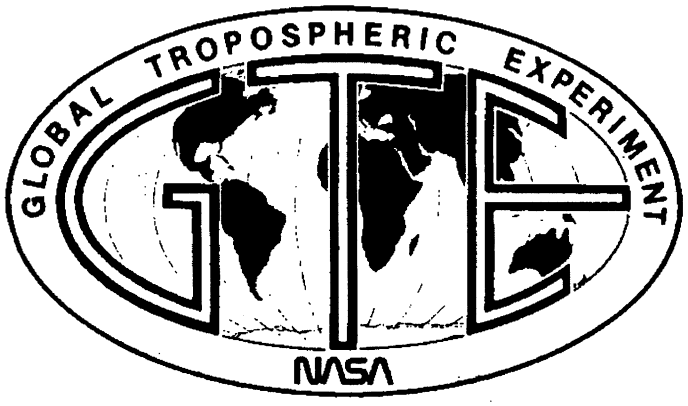

PEM Tropics B; DC-8; FLIGHT 19
CH3ONO2, pptv
C2H5ONO2, pptv
i-C3H7ONO2, pptv
n-C3H7ONO2, pptv
PAN, pptv
GMT Time
Solid = Blake
Broken = Atlas
Solid = Square Singh
Solid = Blake
Broken = Atlas
Solid = Blake
Broken = Atlas
Solid = Blake
Broken = Atlas


PEM Tropics B; DC-8; FLIGHT 19
CH3CFCl2, pptv
15
10
5
Solid = Blake
Broken = Atlas
CH3CF2Cl, pptv
15
10
5
Solid = Blake
Broken = Atlas
CHF2Cl, pptv
140
135
130
125
120
Solid = Blake
Broken = Atlas
CH2Br2, pptv
1.75
1.50
1.25
1.00
0.75
0.50
Solid = Blake
Broken = Atlas
CHBr3, pptv
4
3
2
1
0
Solid = Blake
Broken = Atlas
22
23
24
25
26
27
28
29
30
31
GMT Time


PEM Tropics B; DC-8; FLIGHT 19
J(O3), sec-1
7.5E-5
5.0E-5
2.5E-5
0.0E+0
J(NO2), sec-1
1.5E-2
1.0E-2
5.0E-3
0.0E+0
J(H2O2), sec-1
1.5E-5
1.0E-5
5.0E-6
0.0E+0
J(NO2)z, sec-1
1.5E-2
1.0E-2
5.0E-3
0.0E+0
J(NO2)n, sec-1
1.5E-2
1.0E-2
5.0E-3
0.0E+0
22
23
24
25
26
27
28
29
30
31
GMT Time


PEM Tropics B; DC-8; FLIGHT 19
Altitude, km
15
10
5
0
Cabin Alt, ft
7500
5000
2500
0
Roll Angle, deg.
30
20
10
0
-10
-20
-30
Sun Elevation, deg.
75
50
25
0
CH2Cl2, pptv
20
15
10
5
0
22
23
24
25
26
27
28
29
30
31
GMT Time
Solid = Blake
Broken = Atlas

PLOTS OF FINAL CHEMICAL DATA



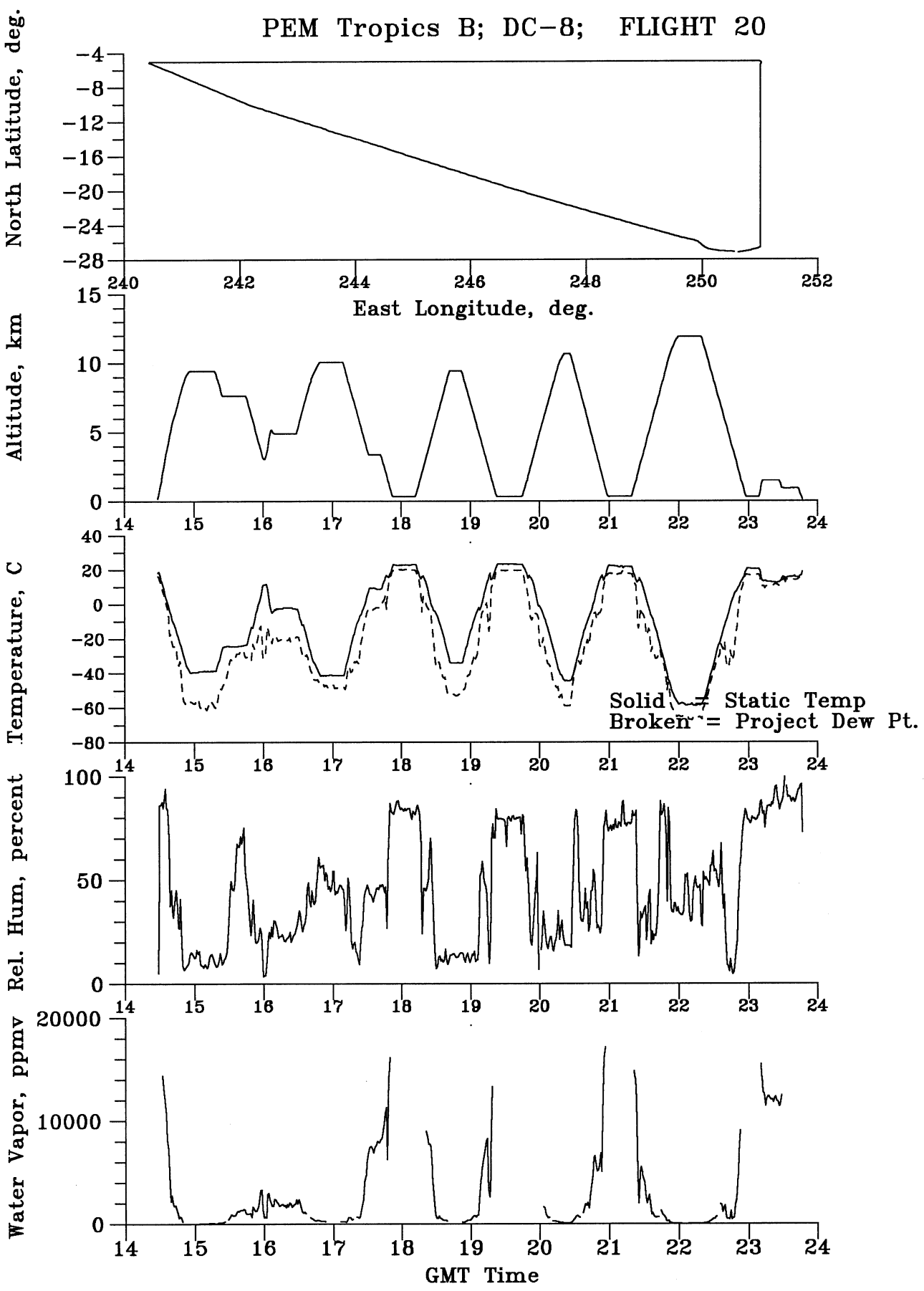
PEM-TROPICS B

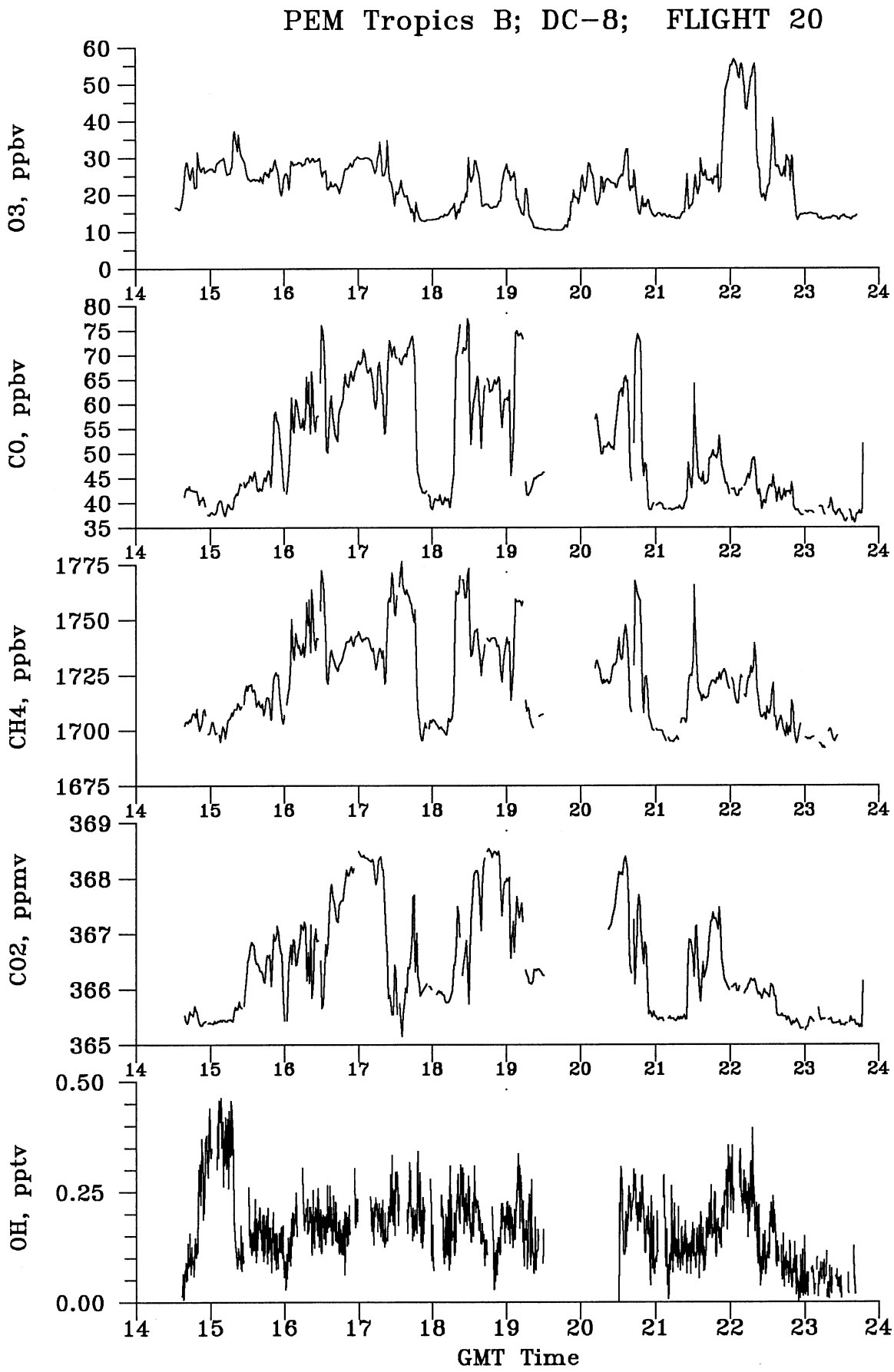
Flight 20D

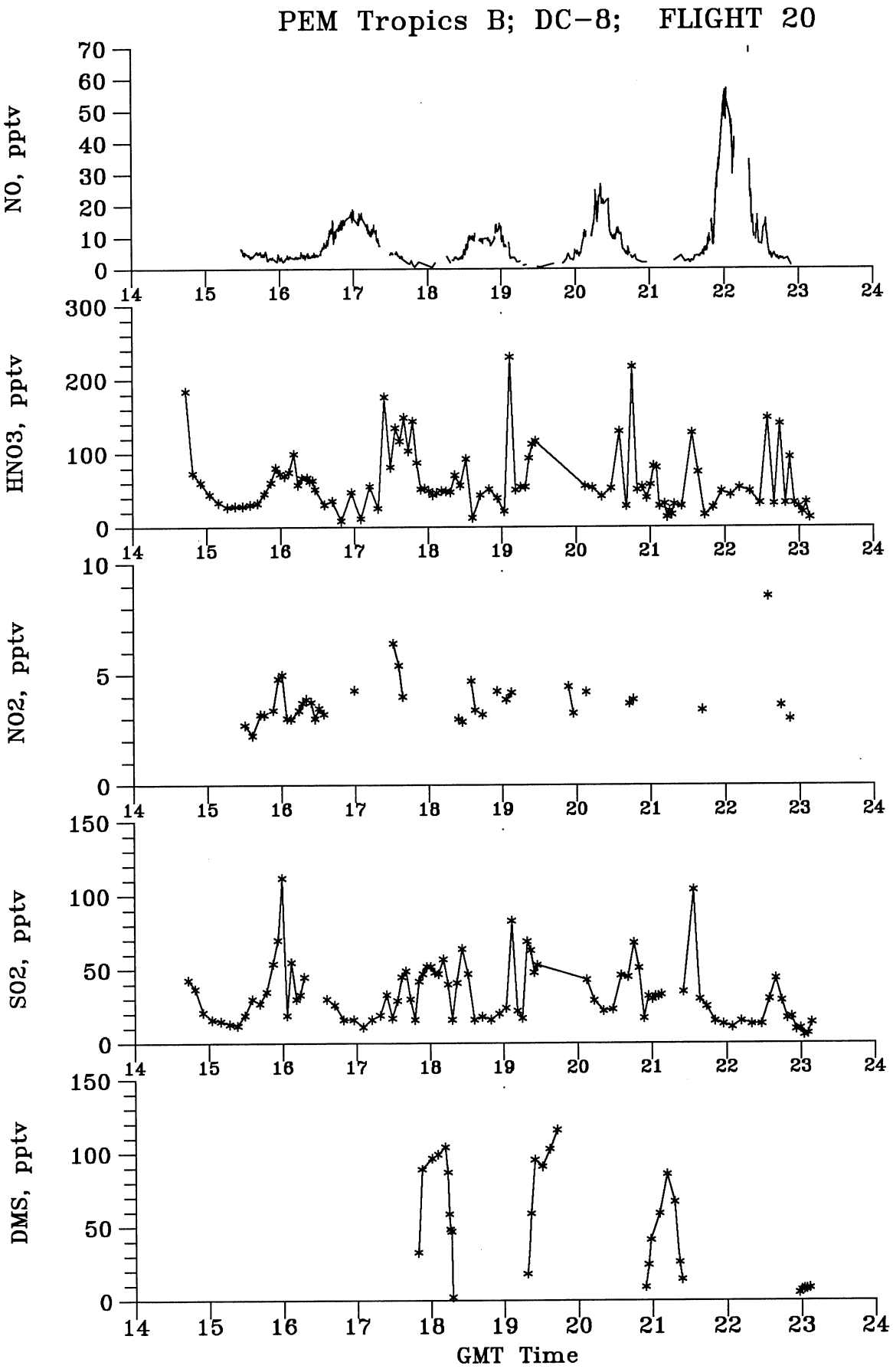
Local: Easter Island No. 1

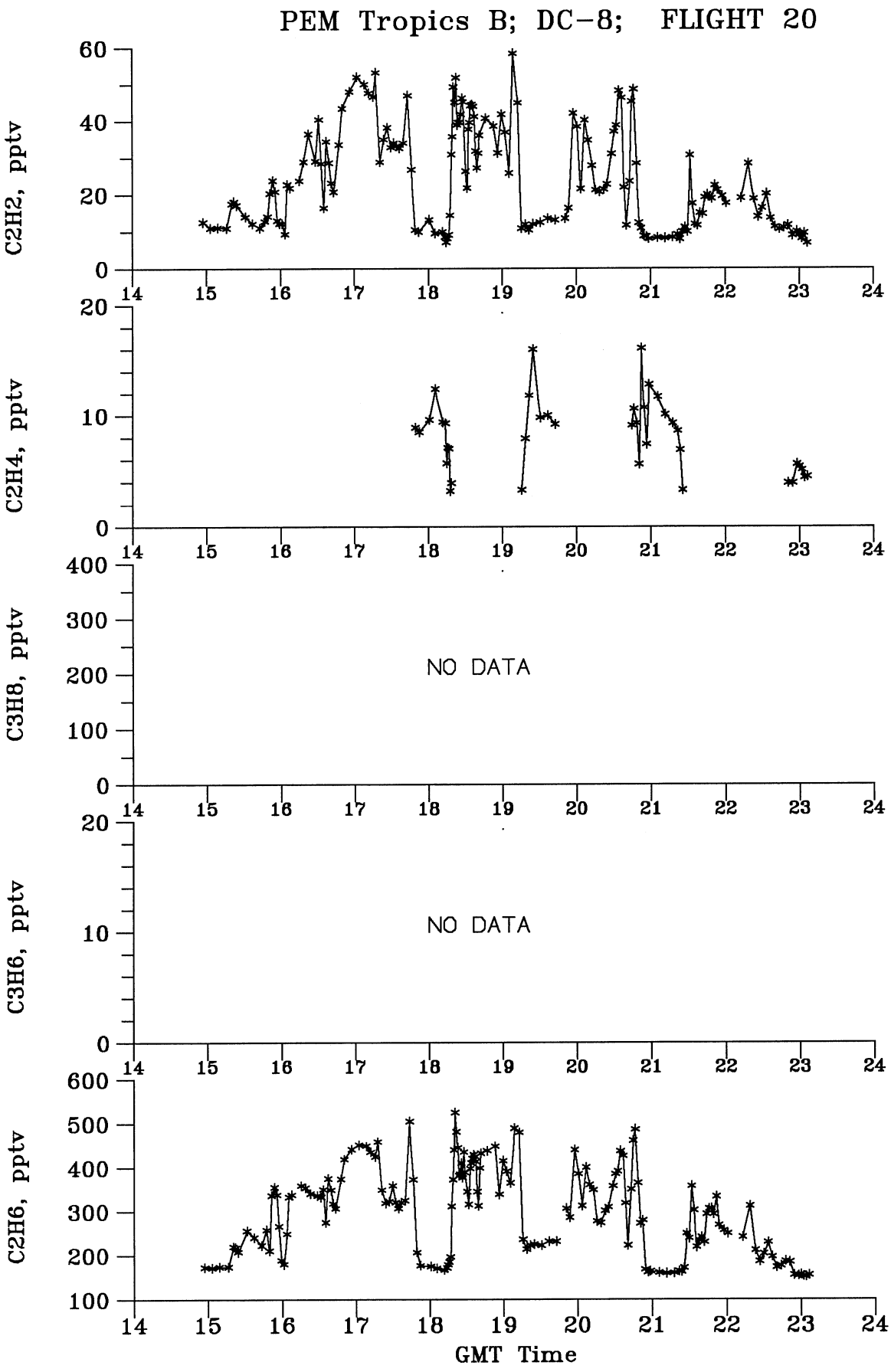
South American Outflow

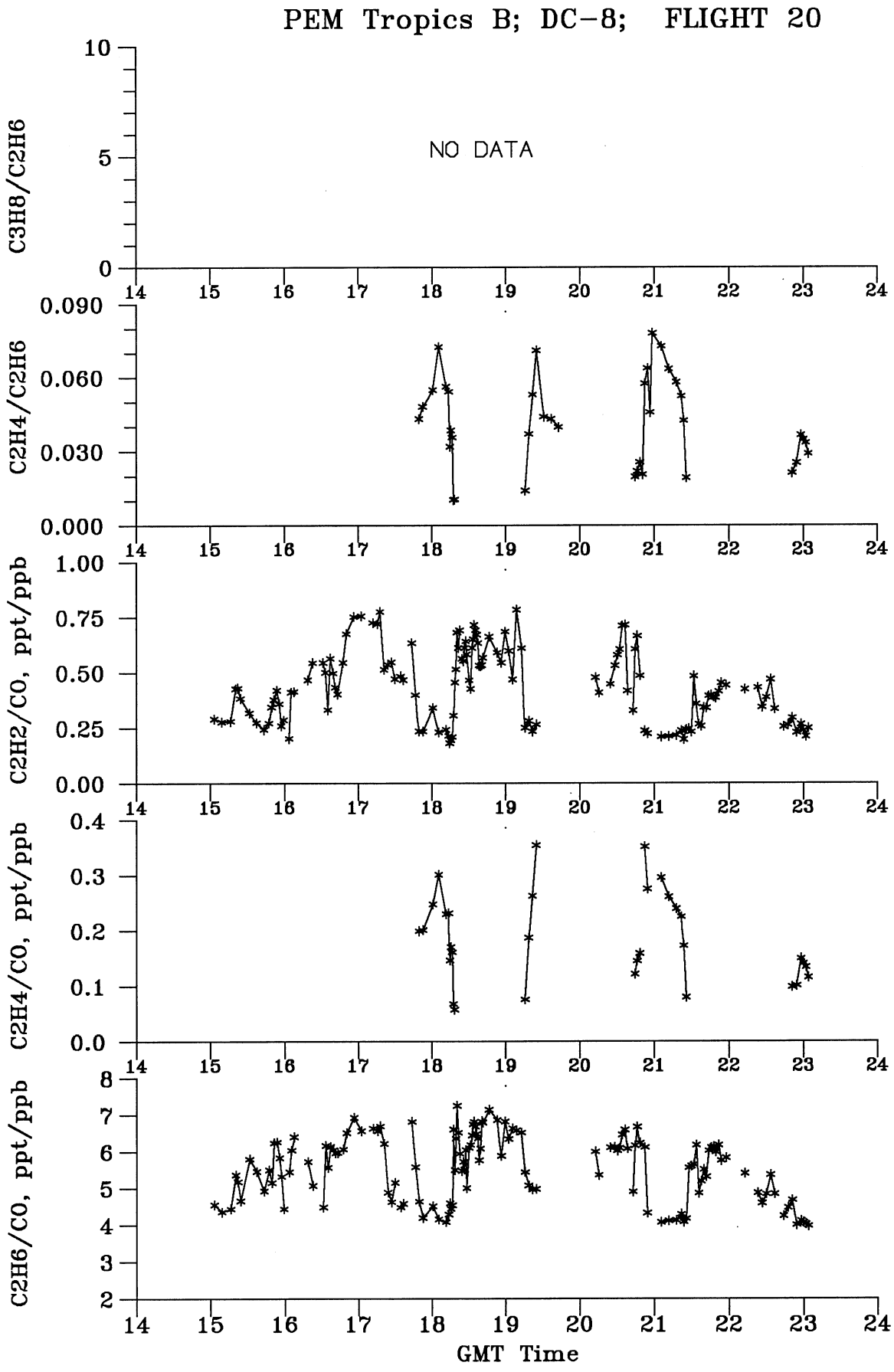
April 15, 1999

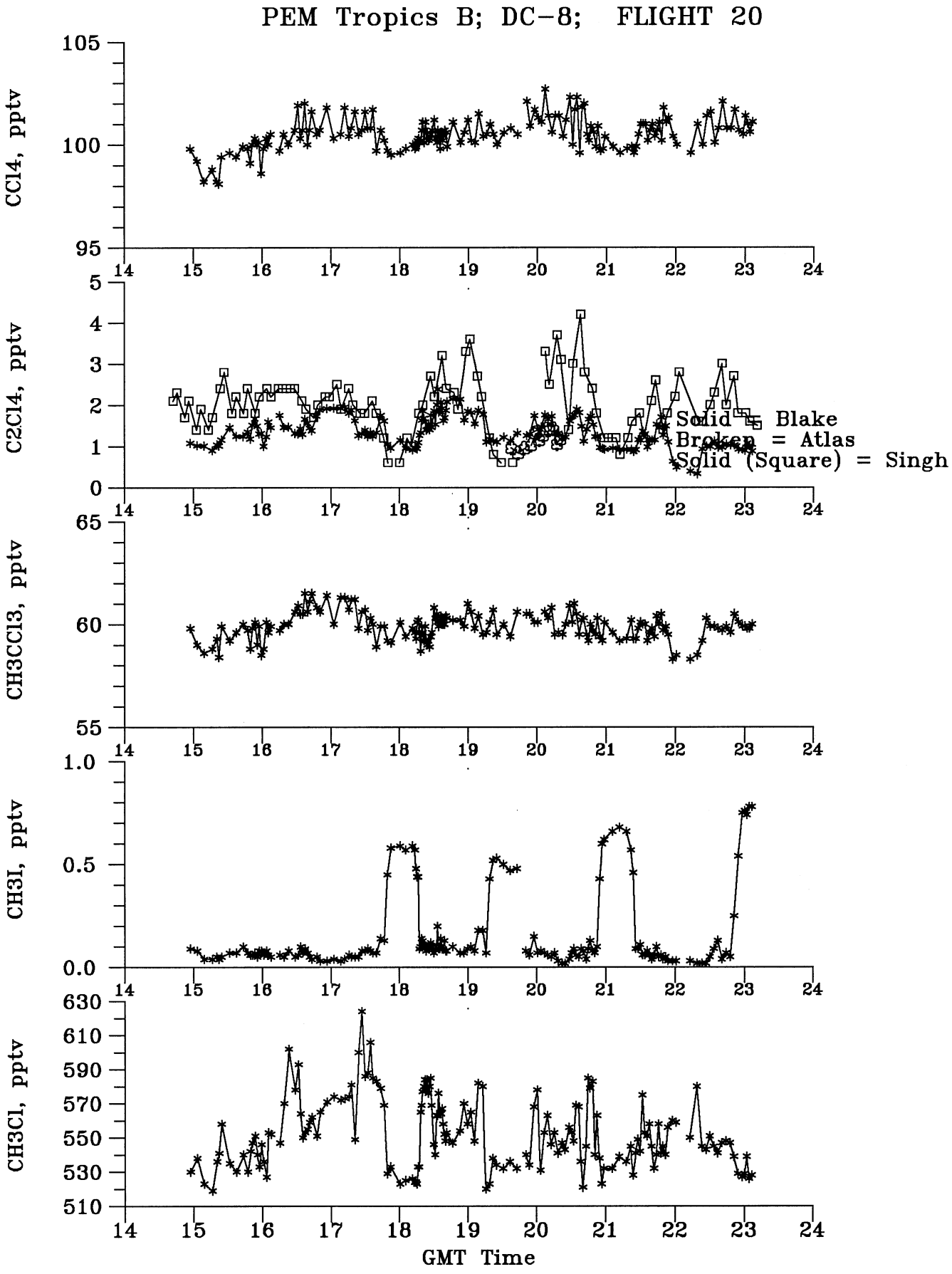

PEM Tropics B; DC-8; FLIGHT 20
North Latitude, deg.
-4
-8
-12
-16
-20
-24
-28
240
242
244
246
248
250
252
East Longitude, deg.
Altitude, km
15
10
5
0
14
15
16
17
18
19
20
21
22
23
24
Temperature, C
40
20
0
-20
-40
-60
-80
Solid = Static Temp
Broken = Project Dew Pt.
Rel. Hum, percent
100
50
0
Water Vapor, ppmv
20000
10000
0
GMT Time

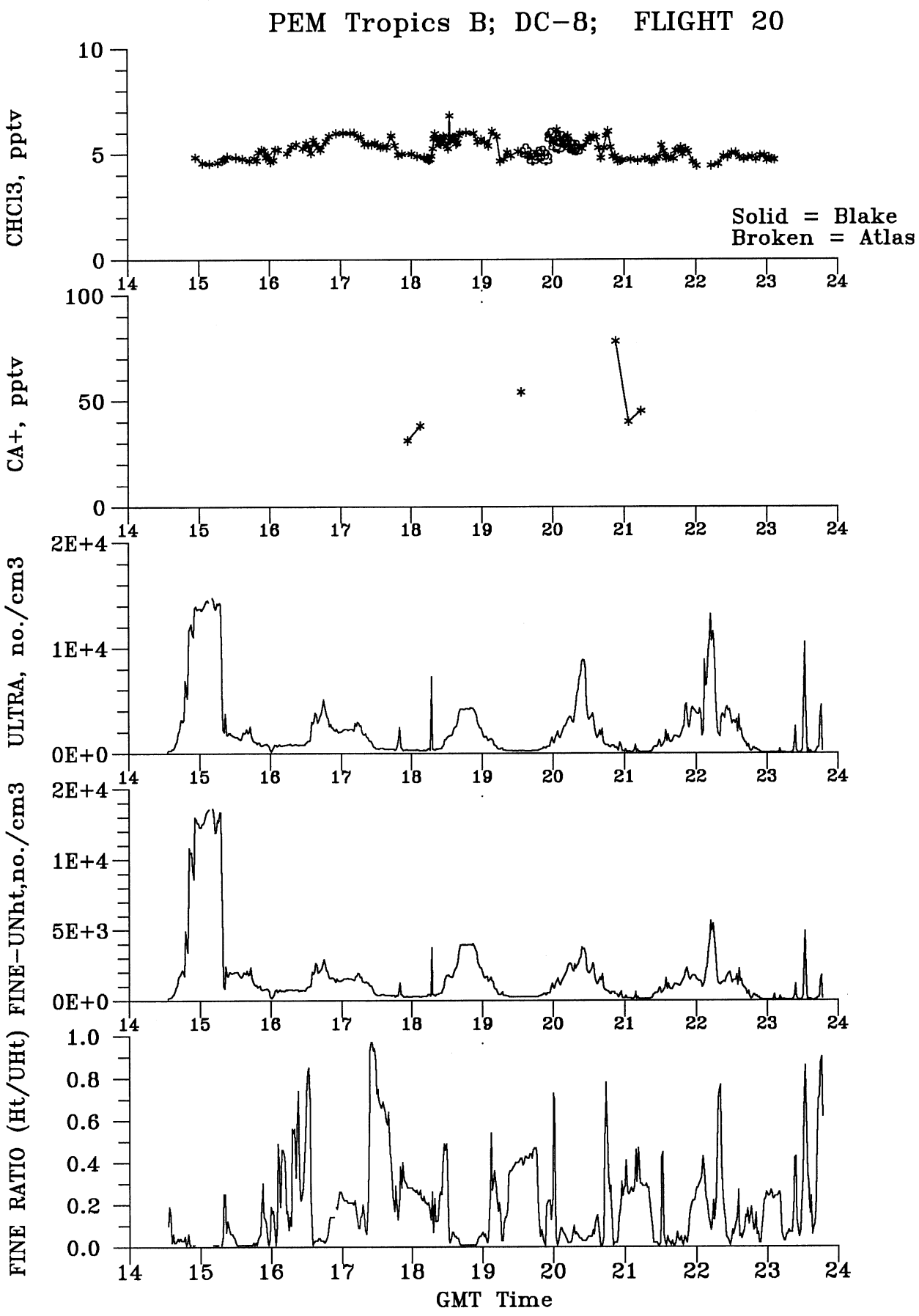

PEM Tropics B; DC-8; FLIGHT 20
O3, ppbv
60
50
40
30
20
10
0
CO, ppbv
80
75
70
65
60
55
50
45
40
35
CH4, ppbv
1775
1750
1725
1700
1675
CO2, ppmv
369
368
367
366
365
OH, pptv
0.50
0.25
0.00
14
15
16
17
18
19
20
21
22
23
24
GMT Time

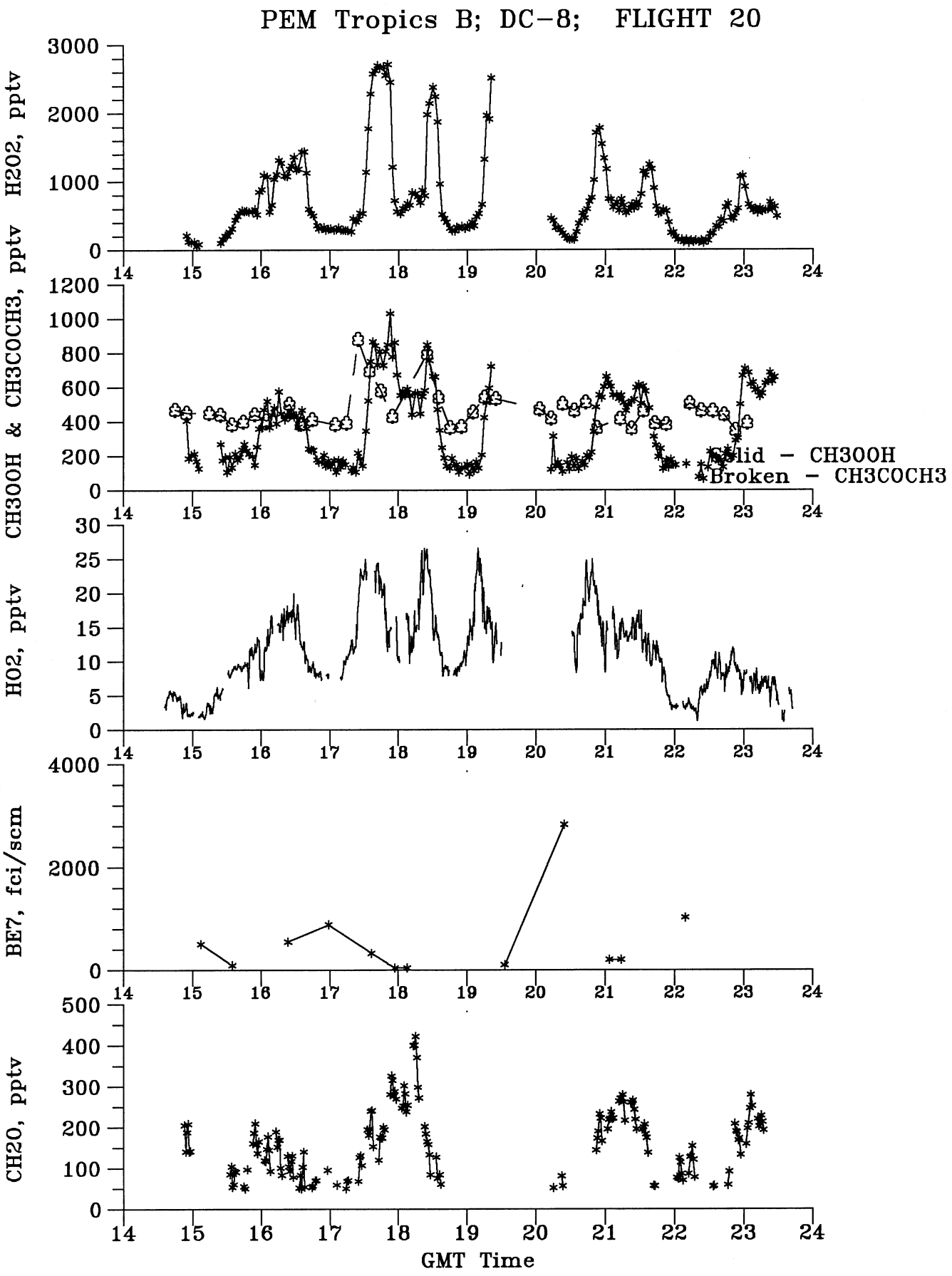

PEM Tropics B; DC-8; FLIGHT 20
NO, pptv
70
60
50
40
30
20
10
0
HNO3, pptv
300
200
100
0
NO2, pptv
10
5
0
SO2, pptv
150
100
50
0
DMS, pptv
150
100
50
0
14
15
16
17
18
19
20
21
22
23
24
GMT Time

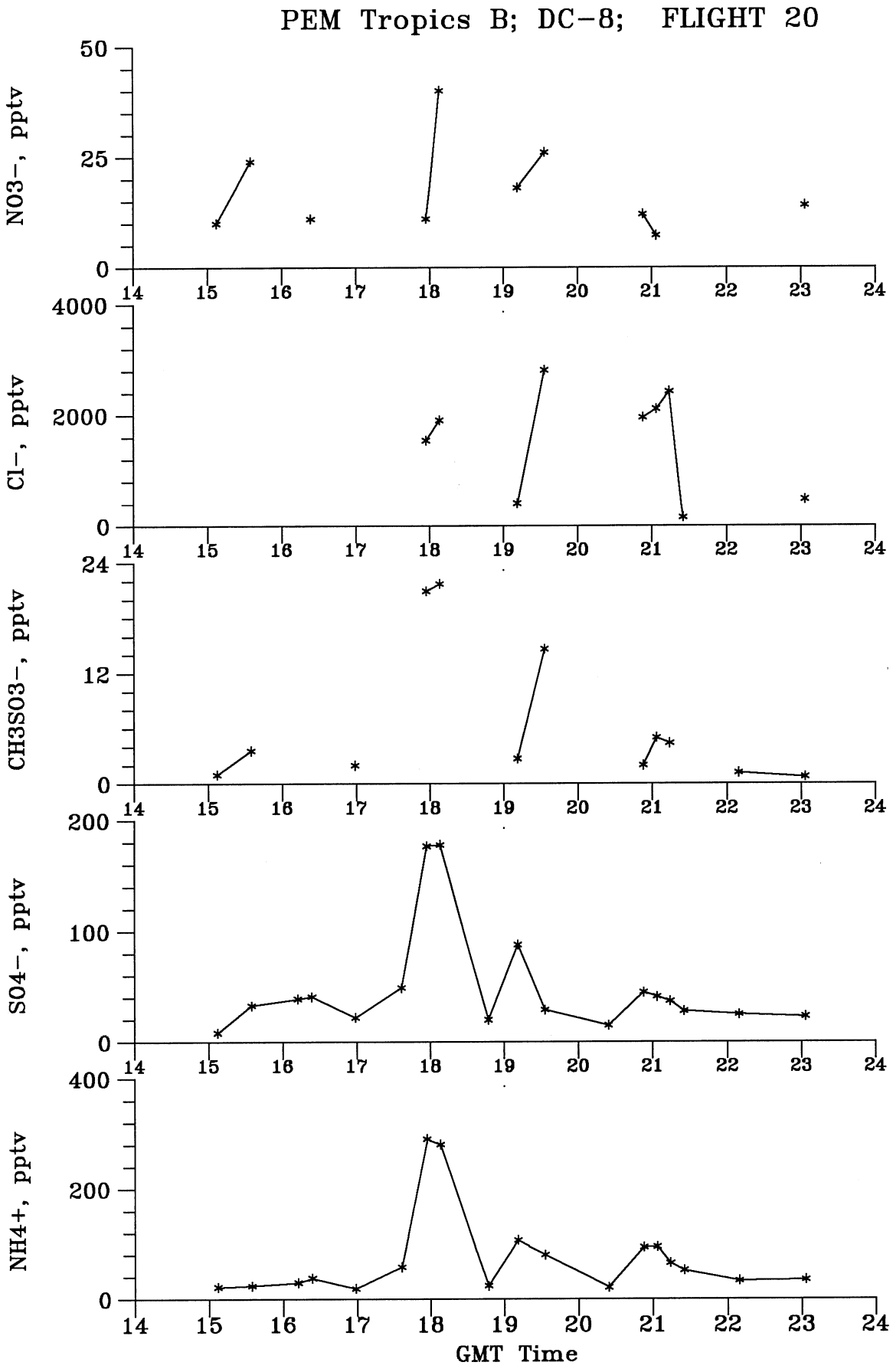

PEM Tropics B; DC-8; FLIGHT 20
C2H2, pptv
C2H4, pptv
C3H8, pptv
NO DATA
C3H6, pptv
NO DATA
C2H6, pptv
GMT Time

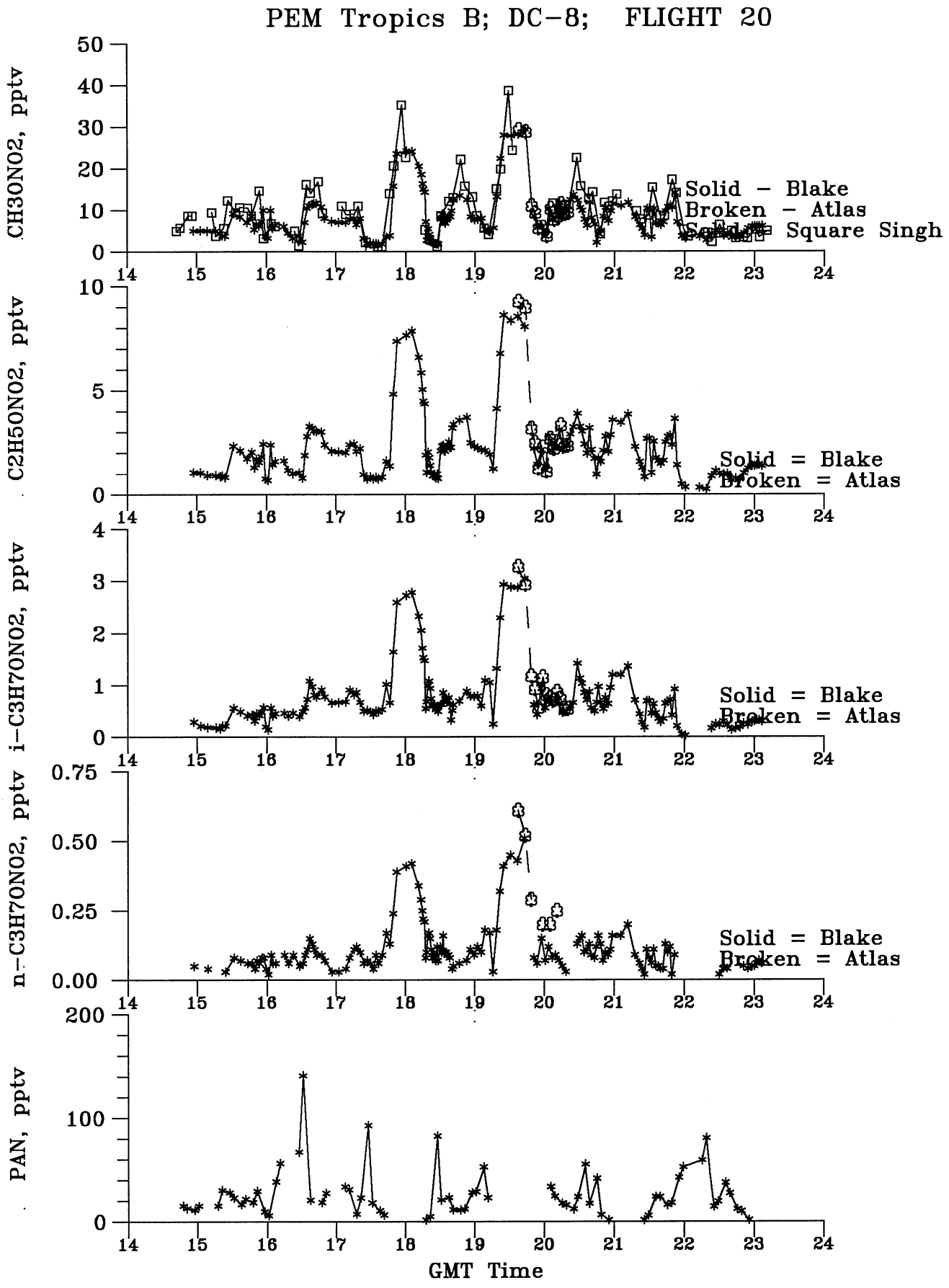

PEM Tropics B; DC-8; FLIGHT 20
C3H8/C2H6
NO DATA
C2H4/C2H6
C2H2/CO, ppt/ppb
C2H4/CO, ppt/ppb
C2H6/CO, ppt/ppb
GMT Time

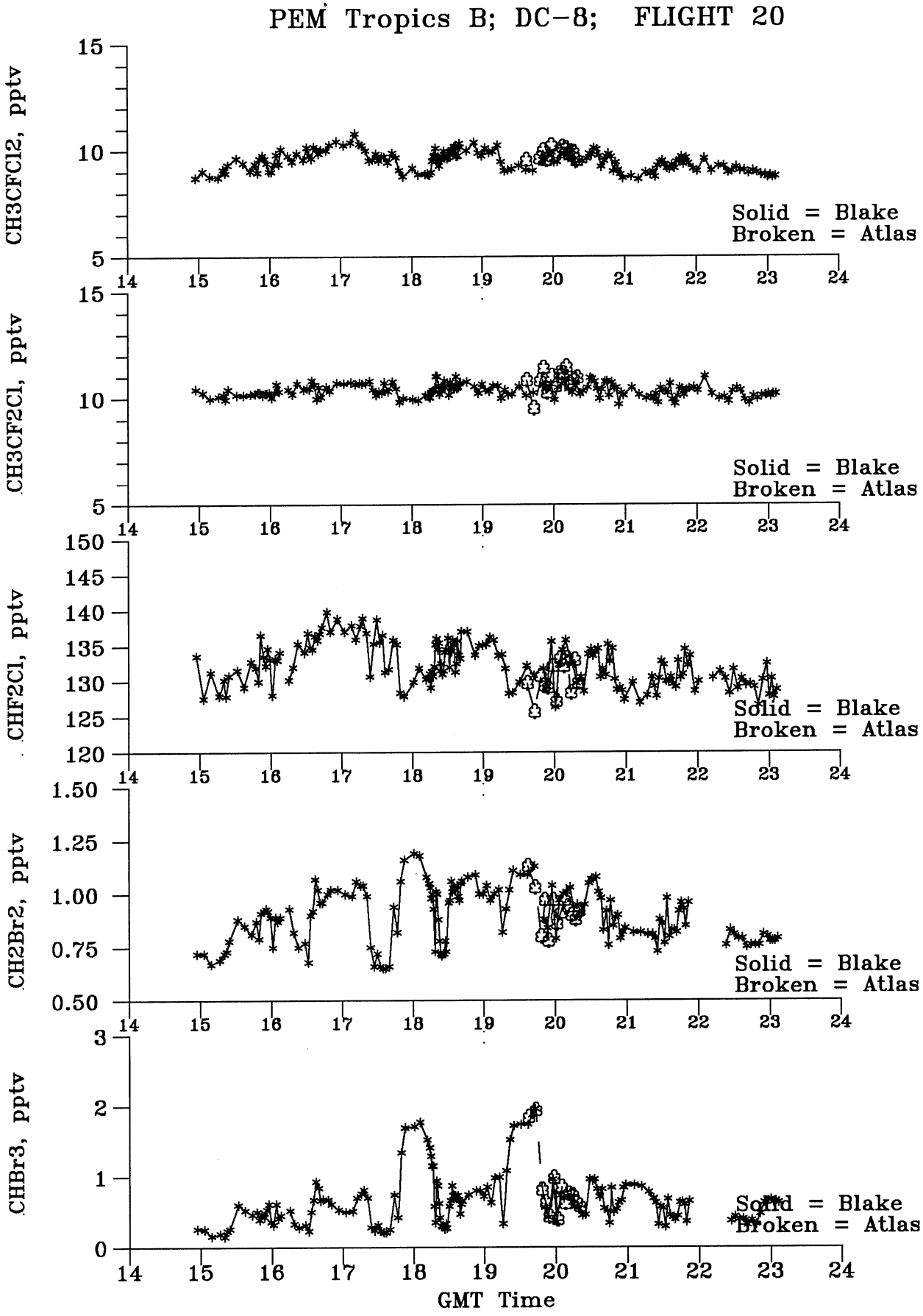

PEM Tropics B; DC-8; FLIGHT 20
CCl4, pptv
105
100
95
C2Cl4, pptv
5
4
3
2
1
0
Solid = Blake
Broken = Atlas
Solid (Square) = Singh
CH3CCl3, pptv
65
60
55
CH3I, pptv
1.0
0.5
0.0
CH3Cl, pptv
630
610
590
570
550
530
510
14
15
16
17
18
19
20
21
22
23
24
GMT Time

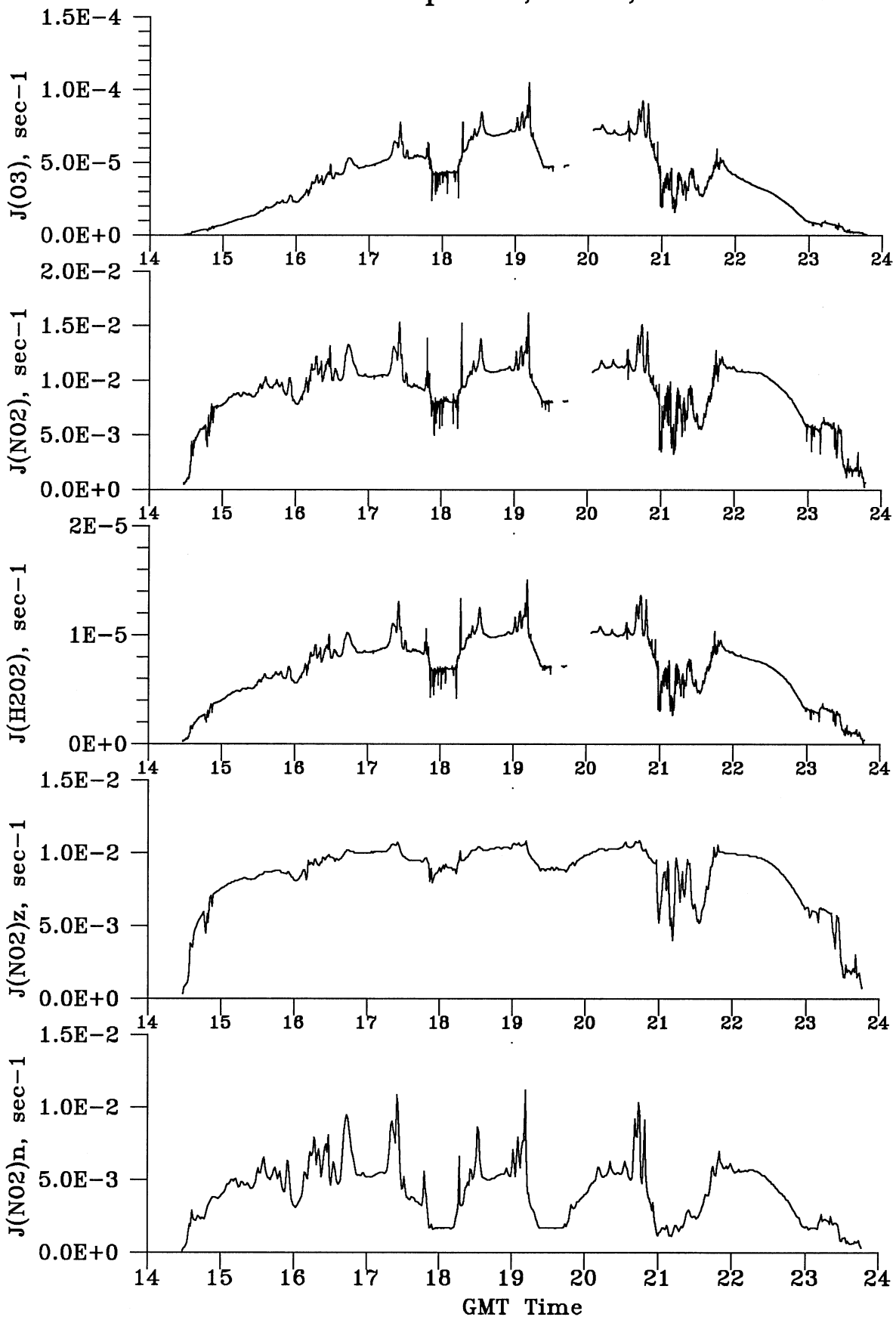

PEM Tropics B; DC-8; FLIGHT 20
CHCl3, pptv
Solid = Blake
Broken = Atlas
CA+, pptv
ULTRA, no./cm3
FINE-UNht,no./cm3
FINE RATIO (Ht/UHt)
GMT Time

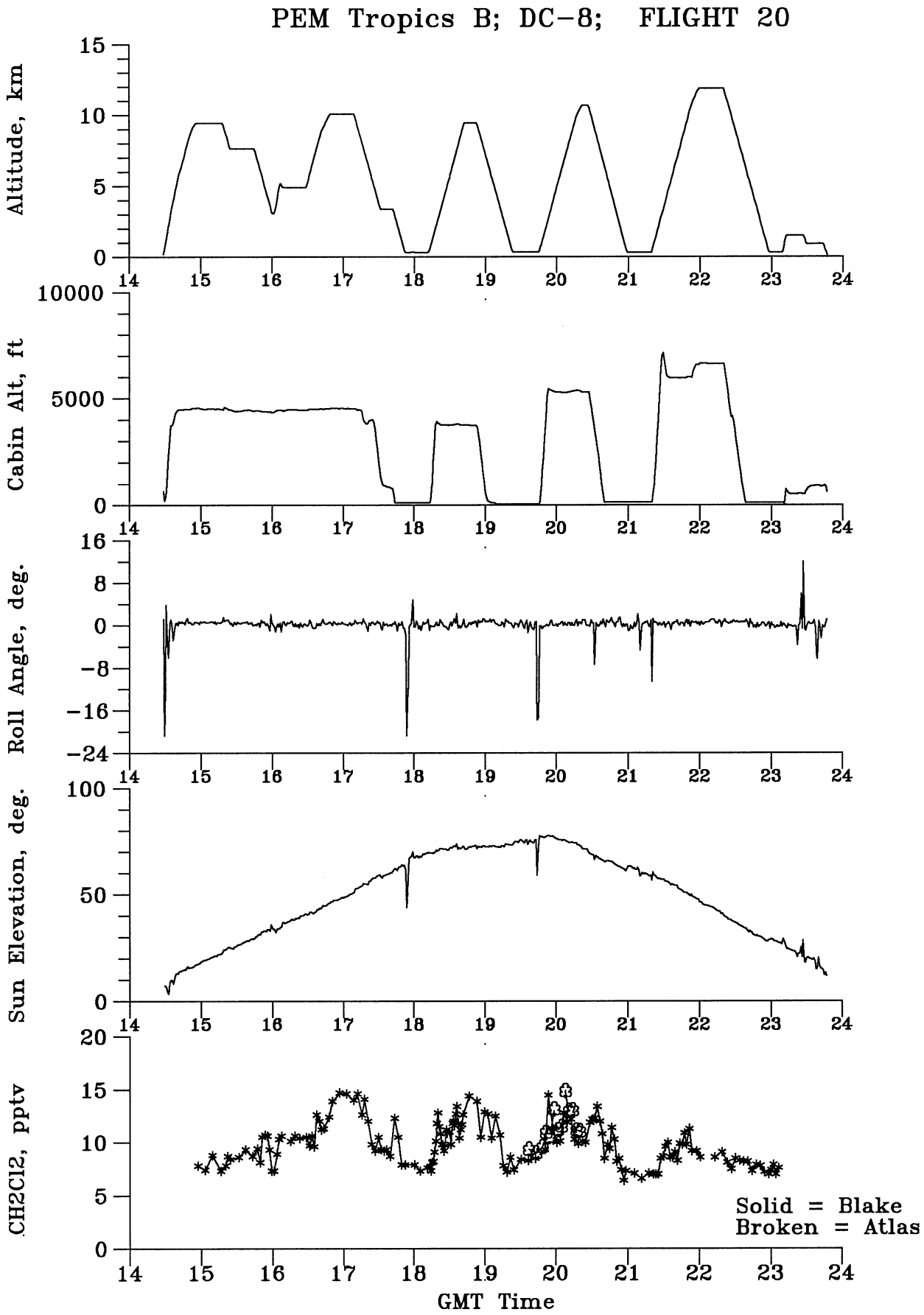

PEM Tropics B; DC-8; FLIGHT 20
H2O2, pptv
CH3OOH & CH3COCH3, pptv
Solid - CH3OOH
Broken - CH3COCH3
HO2, pptv
BE7, fci/scm
CH2O, pptv
GMT Time


PEM Tropics B; DC-8; FLIGHT 20
NO3-, pptv
50
25
0
Cl-, pptv
4000
2000
0
CH3SO3-, pptv
24
12
0
SO4-, pptv
200
100
0
NH4+, pptv
400
200
0
14 15 16 17 18 19 20 21 22 23 24
GMT Time

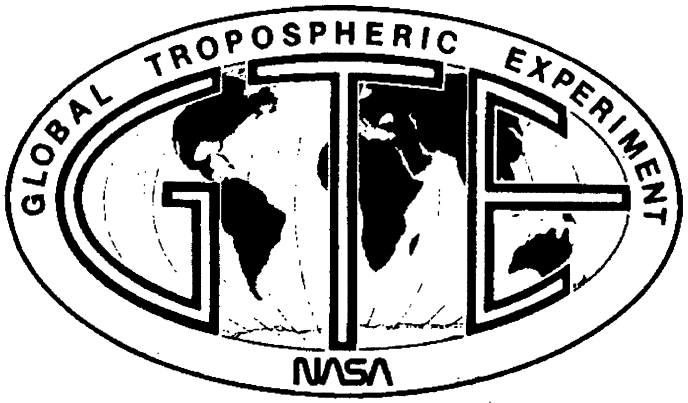

PEM Tropics B; DC-8; FLIGHT 20
CH3ONO2, pptv
Solid - Blake
Broken - Atlas
Square Singh
C2H5ONO2, pptv
Solid = Blake
Broken = Atlas
n-C3H7ONO2, pptv i-C3H7ONO2, pptv
Solid = Blake
Broken = Atlas
Solid = Blake
Broken = Atlas
PAN, pptv
GMT Time


PEM Tropics B; DC-8; FLIGHT 20
CH3CFCl2, pptv
CH3CF2Cl, pptv
CHF2Cl, pptv
CH2Br2, pptv
CHBr3, pptv
Solid = Blake
Broken = Atlas
GMT Time


PEM Tropics B; DC-8; FLIGHT 20
J(O3), sec-1
1.5E-4
1.0E-4
5.0E-5
0.0E+0
J(NO2), sec-1
2.0E-2
1.5E-2
1.0E-2
5.0E-3
0.0E+0
J(H2O2), sec-1
2E-5
1E-5
0E+0
J(NO2)z, sec-1
1.5E-2
1.0E-2
5.0E-3
0.0E+0
J(NO2)n, sec-1
1.5E-2
1.0E-2
5.0E-3
0.0E+0
14 15 16 17 18 19 20 21 22 23 24
GMT Time


PEM Tropics B; DC-8; FLIGHT 20
Altitude, km
15
10
5
0
Cabin Alt, ft
10000
5000
0
Roll Angle, deg.
16
8
0
-8
-16
-24
Sun Elevation, deg.
100
50
0
CH2Cl2, pptv
20
15
10
5
0
14
15
16
17
18
19
20
21
22
23
24
GMT Time
Solid = Blake
Broken = Atlas

PLOTS OF FINAL CHEMICAL DATA



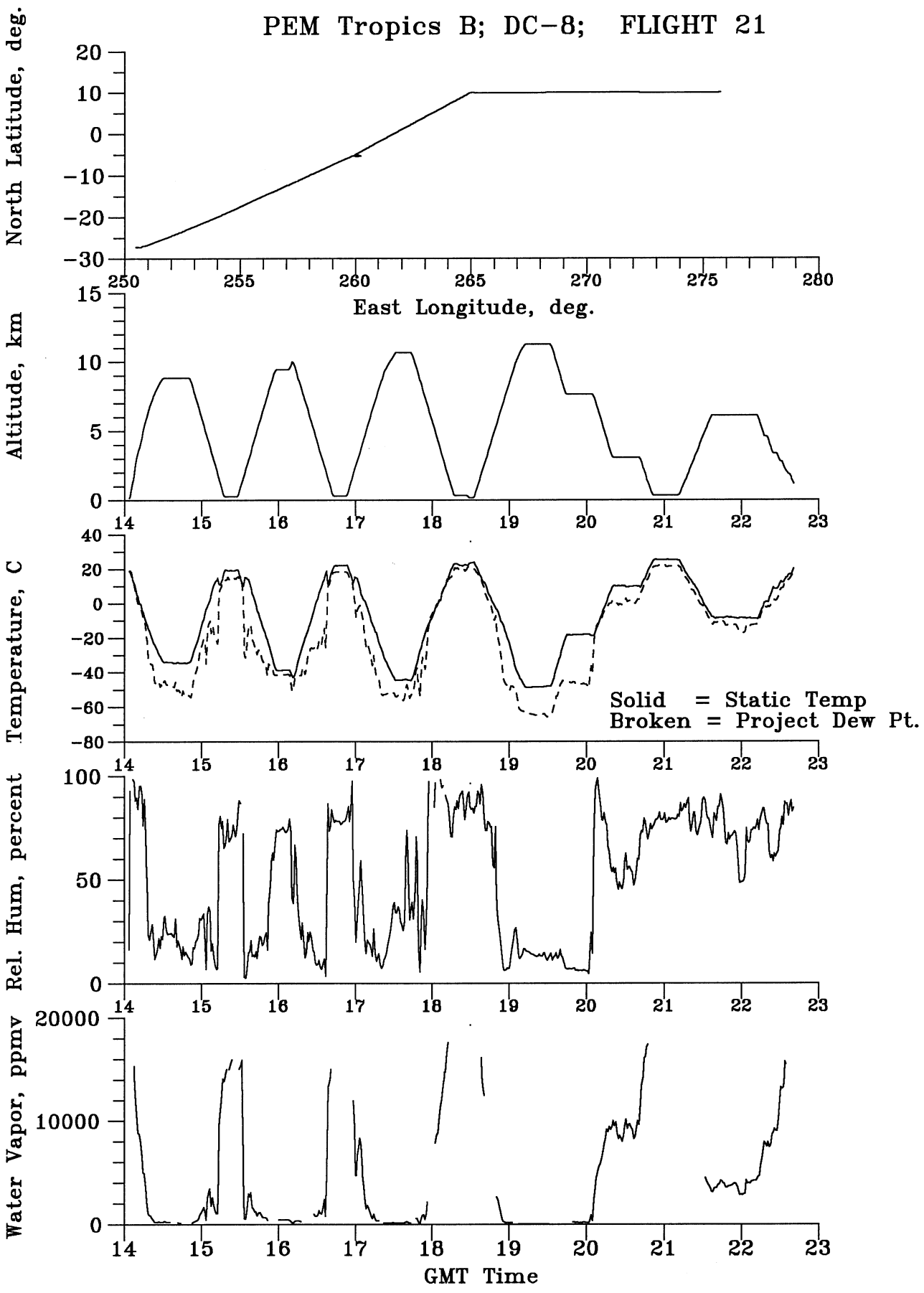
PEM-TROPICS B

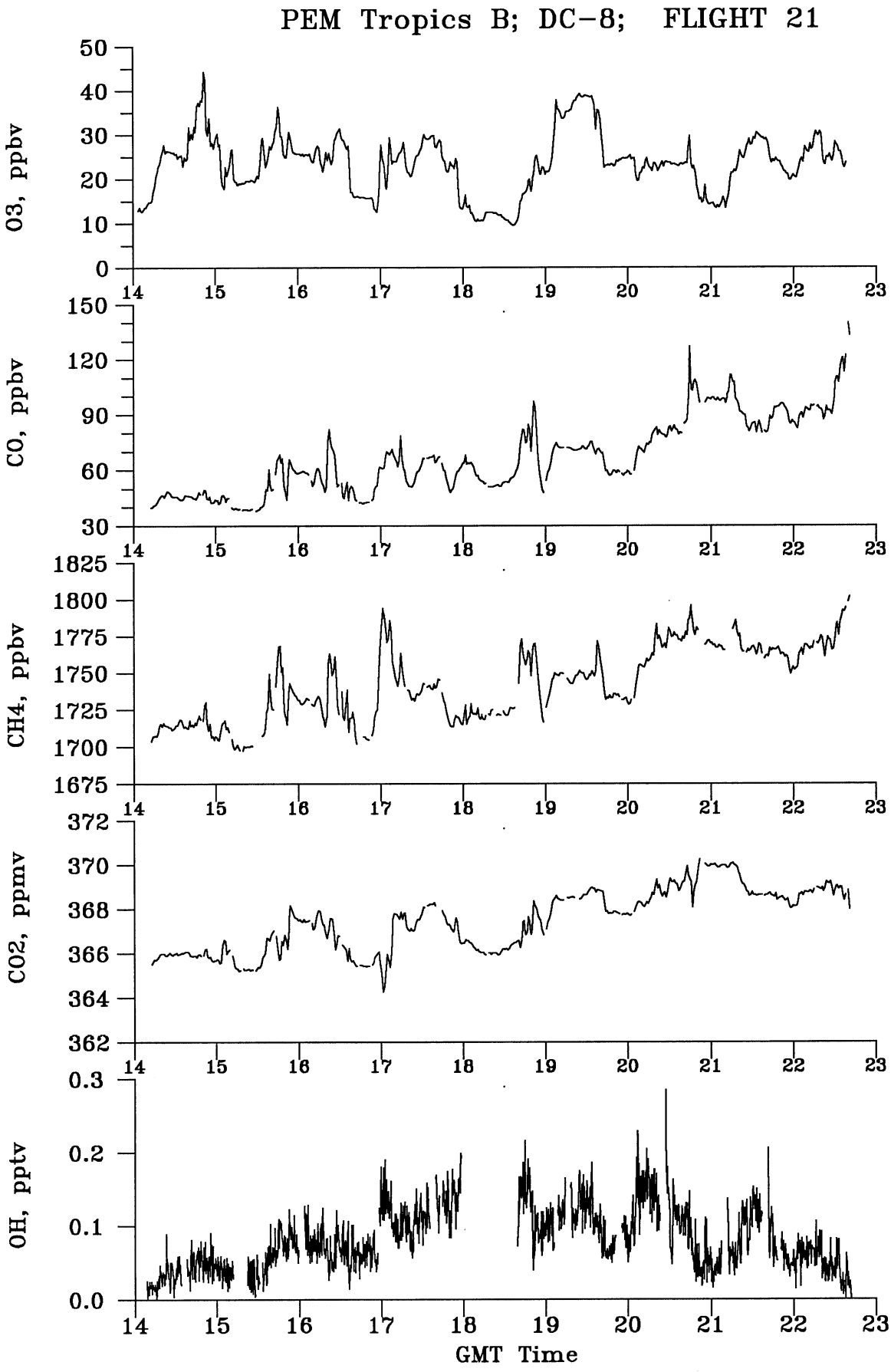
Flight 21D

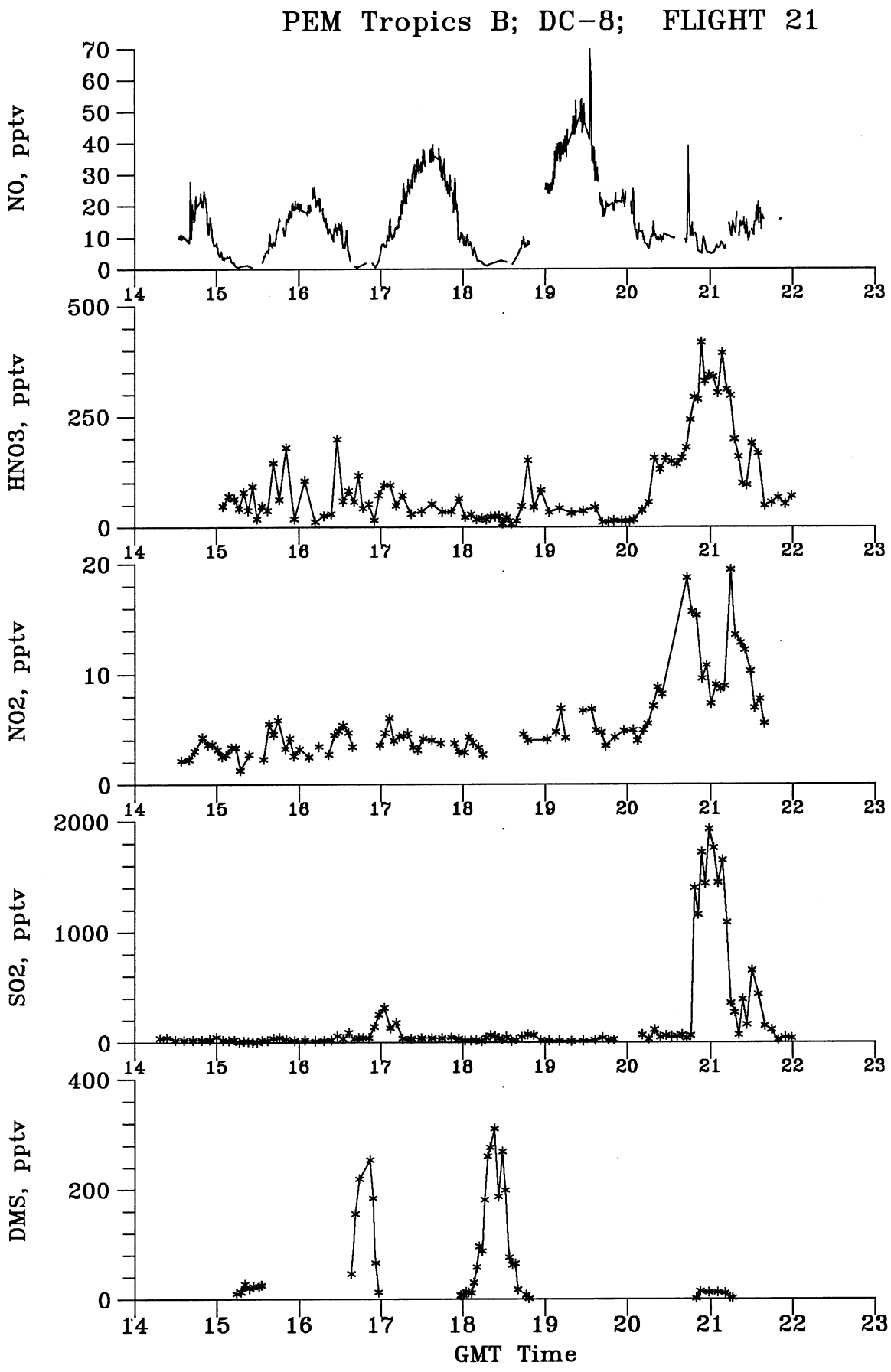
Transit: Easter Island to Costa Rica

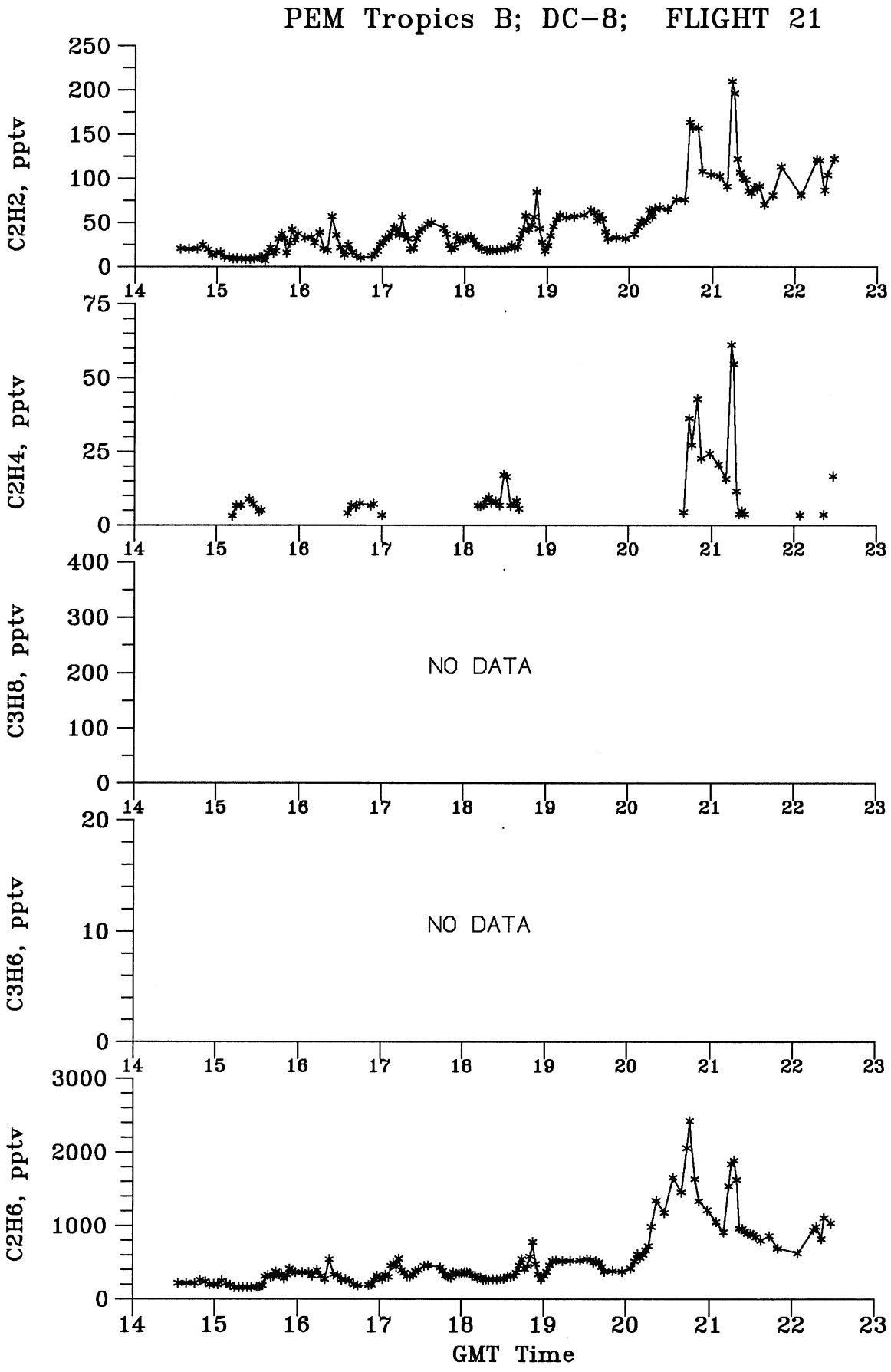
South/Central American Outflow

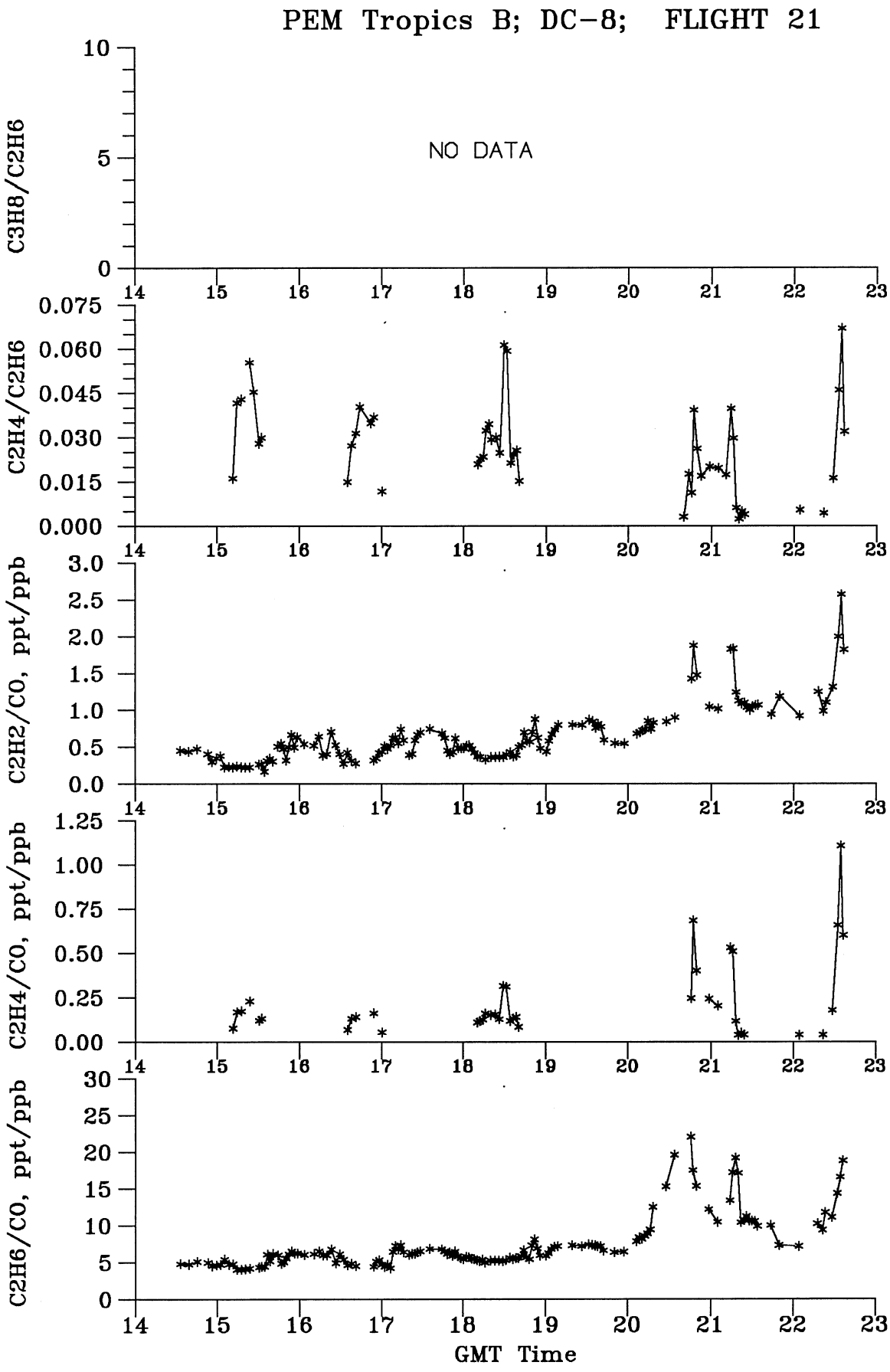
April 17, 1999

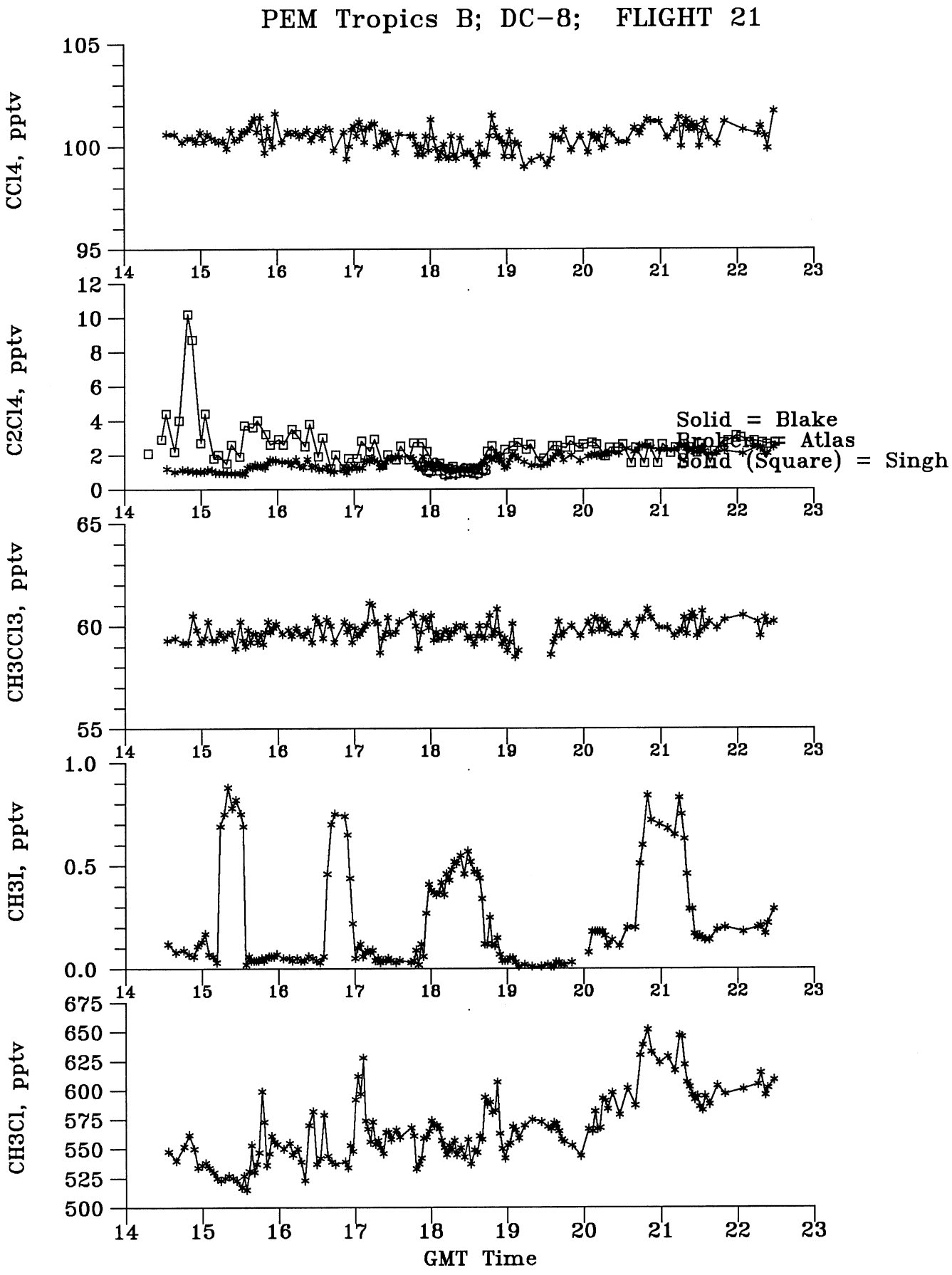

PEM Tropics B; DC-8; FLIGHT 21
North Latitude, deg.
20
10
0
-10
-20
-30
250
255
260
265
270
275
280
East Longitude, deg.
Altitude, km
15
10
5
0
14
15
16
17
18
19
20
21
22
23
Temperature, C
40
20
0
-20
-40
-60
-80
Solid = Static Temp
Broken = Project Dew Pt.
Rel. Hum, percent
100
50
0
Water Vapor, ppmv
20000
10000
0
GMT Time

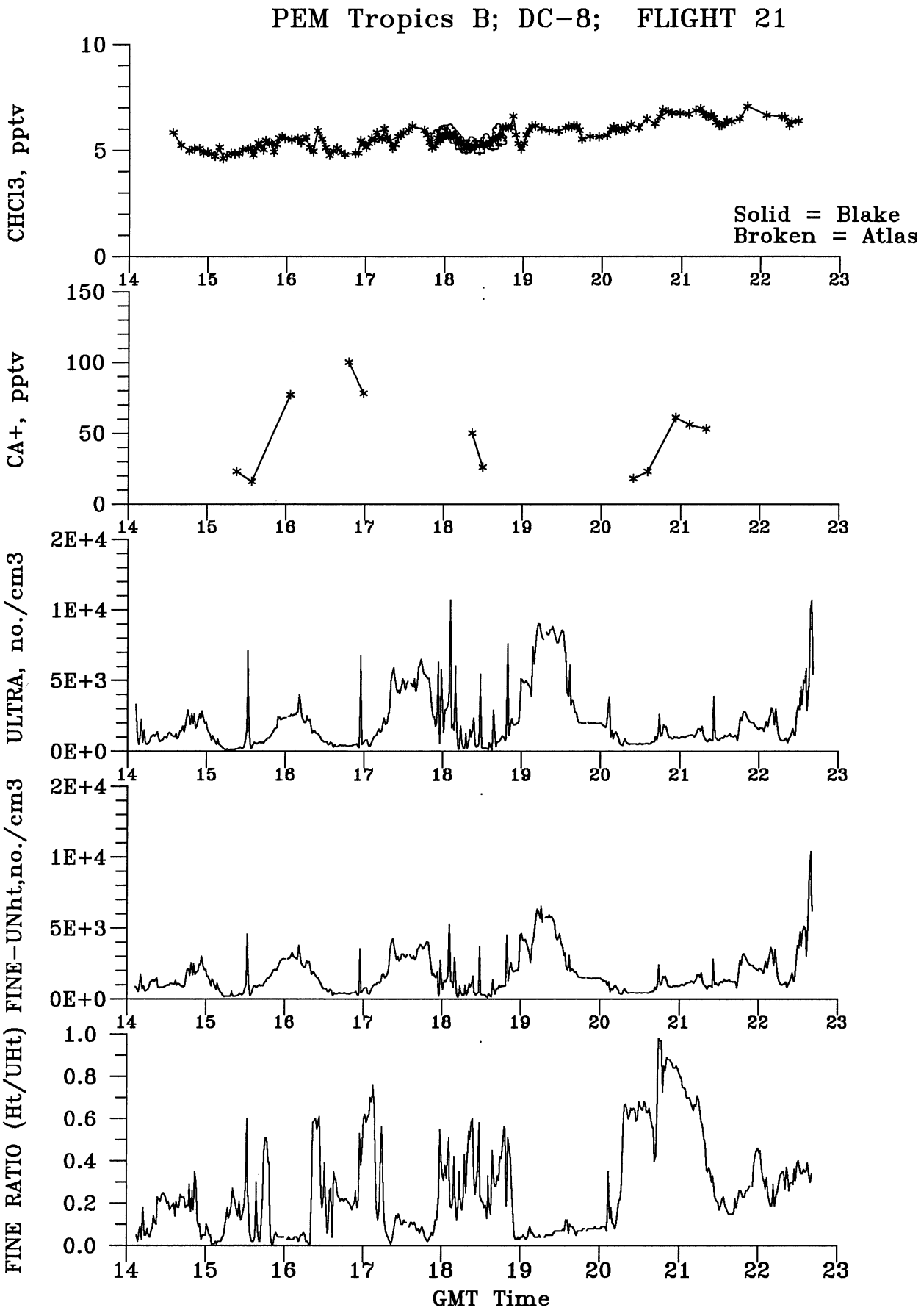

PEM Tropics B; DC-8; FLIGHT 21
O3, ppbv
50
40
30
20
10
0
CO, ppbv
150
120
90
60
30
CH4, ppbv
1825
1800
1775
1750
1725
1700
1675
CO2, ppmv
372
370
368
366
364
362
OH, pptv
0.3
0.2
0.1
0.0
14
15
16
17
18
19
20
21
22
23
GMT Time

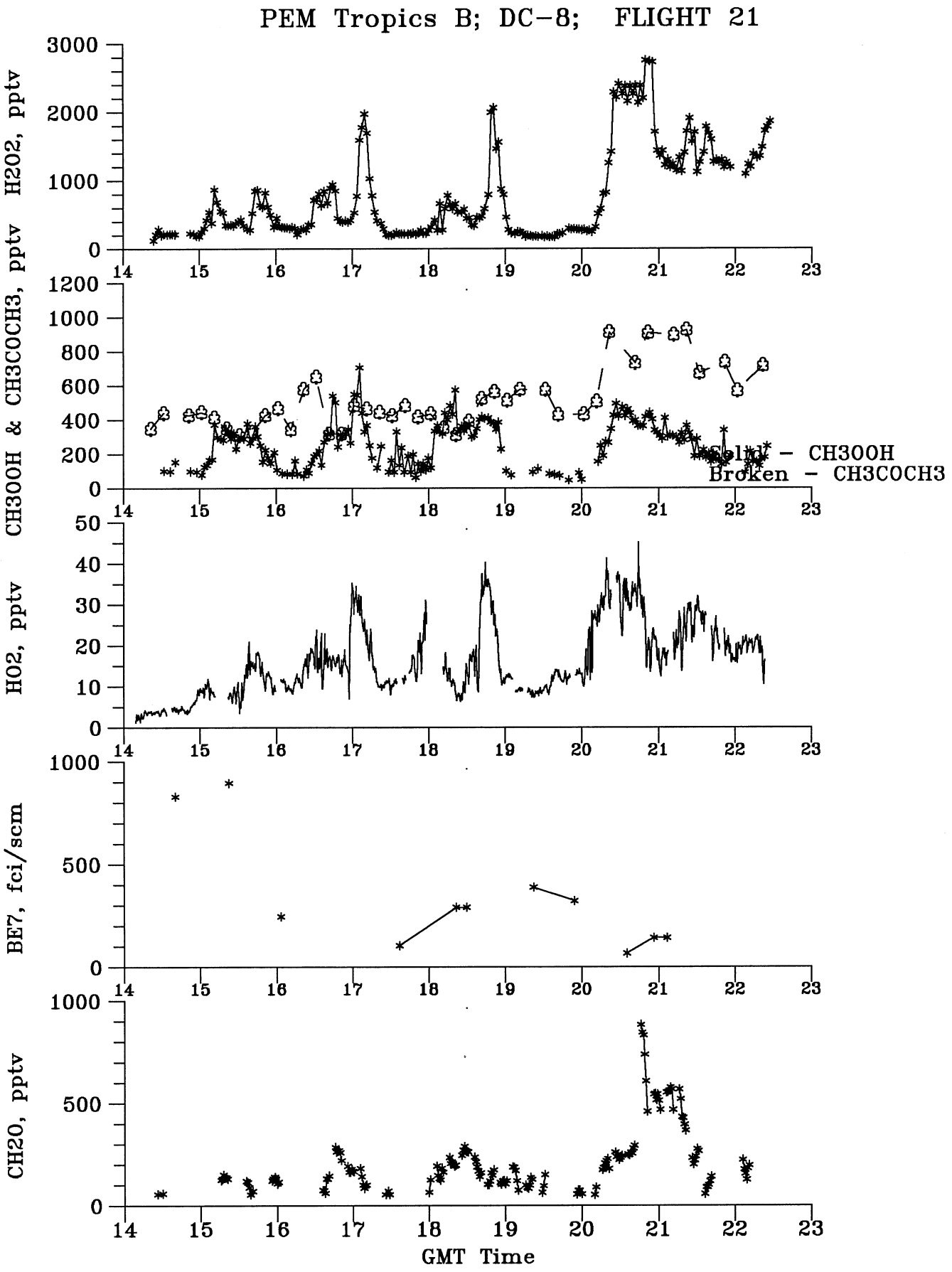

PEM Tropics B; DC-8; FLIGHT 21
NO, pptv
70
60
50
40
30
20
10
0
HNO3, pptv
500
250
0
NO2, pptv
20
10
0
SO2, pptv
2000
1000
0
DMS, pptv
400
200
0
14
15
16
17
18
19
20
21
22
23
GMT Time

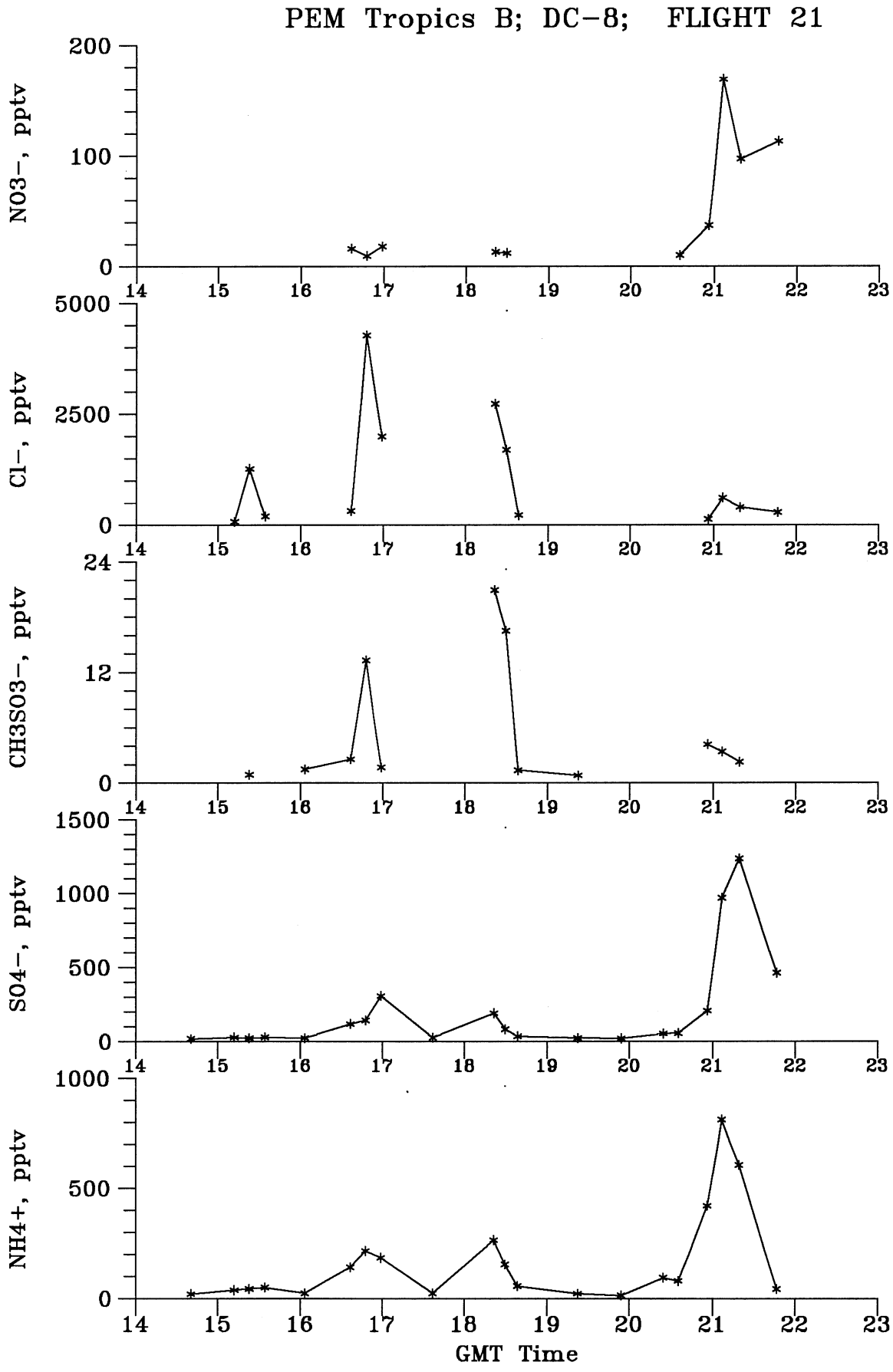

PEM Tropics B; DC-8; FLIGHT 21
C2H2, pptv
250
200
150
100
50
0
C2H4, pptv
75
50
25
0
C3H8, pptv
400
300
200
100
0
NO DATA
C3H6, pptv
20
10
0
NO DATA
C2H6, pptv
3000
2000
1000
0
14
15
16
17
18
19
20
21
22
23
GMT Time

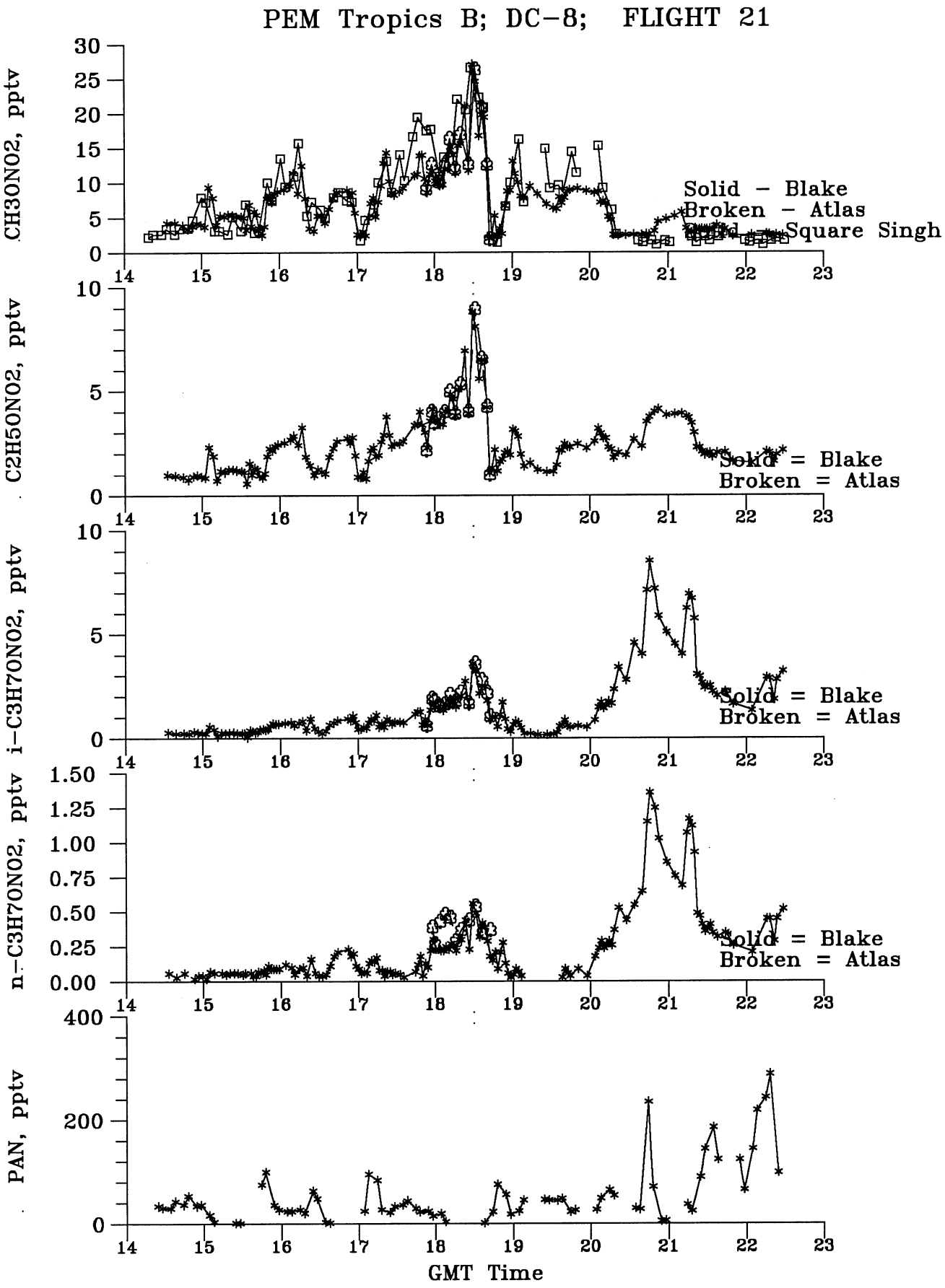

PEM Tropics B; DC-8; FLIGHT 21
C3H8/C2H6
NO DATA
C2H4/C2H6
C2H2/CO, ppt/ppb
C2H4/CO, ppt/ppb
C2H6/CO, ppt/ppb
GMT Time

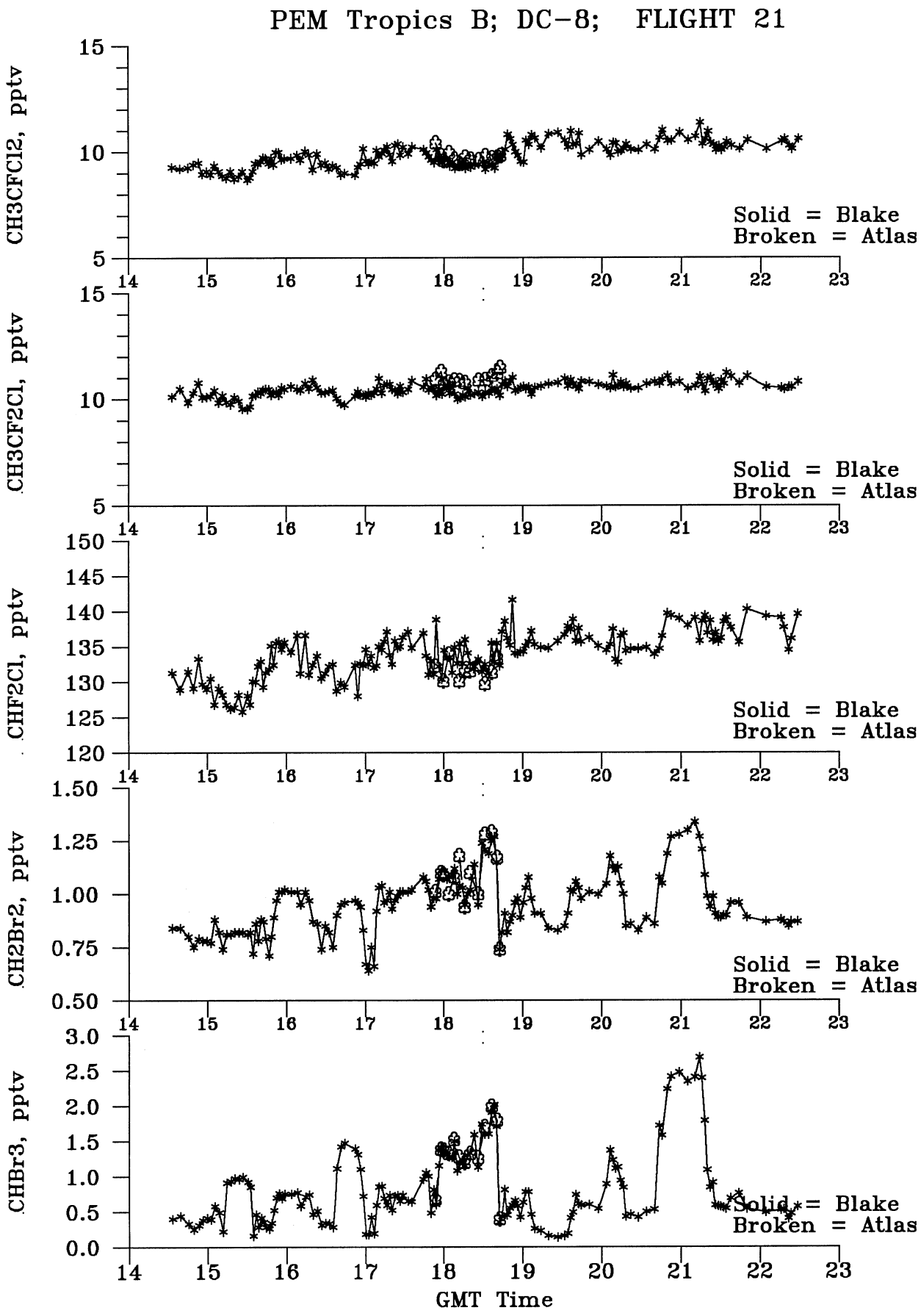

PEM Tropics B; DC-8; FLIGHT 21
CCl4, pptv
105
100
95
C2Cl4, pptv
12
10
8
6
4
2
0
Solid = Blake
Broken = Atlas
Solid (Square) = Singh
CH3CCl3, pptv
65
60
55
CH3I, pptv
1.0
0.5
0.0
CH3Cl, pptv
675
650
625
600
575
550
525
500
14
15
16
17
18
19
20
21
22
23
GMT Time

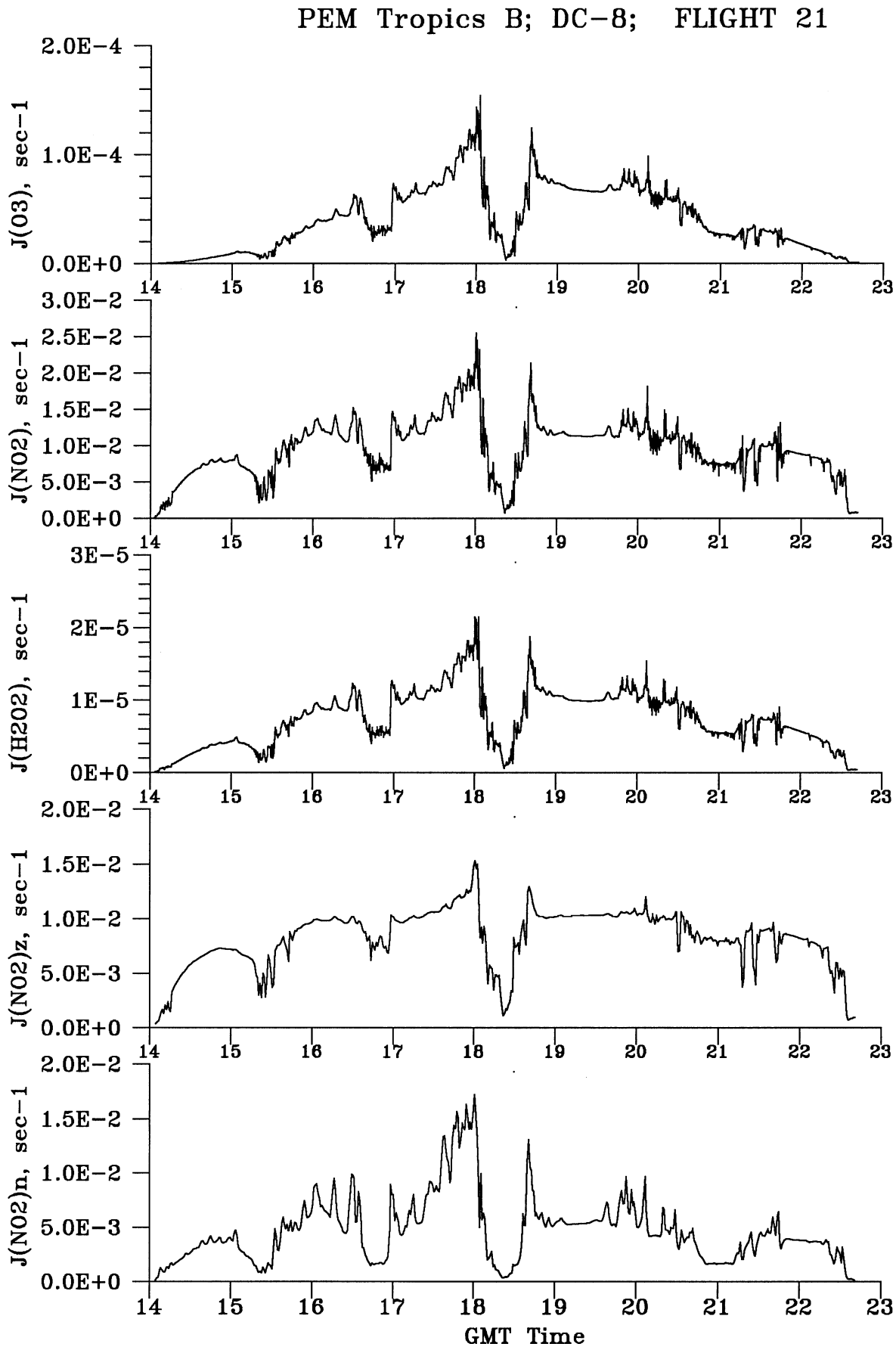

PEM Tropics B; DC-8; FLIGHT 21
CHCl3, pptv
Solid = Blake
Broken = Atlas
CA+, pptv
ULTRA, no./cm3
FINE-UNht,no./cm3
FINE RATIO (Ht/UHt)
GMT Time

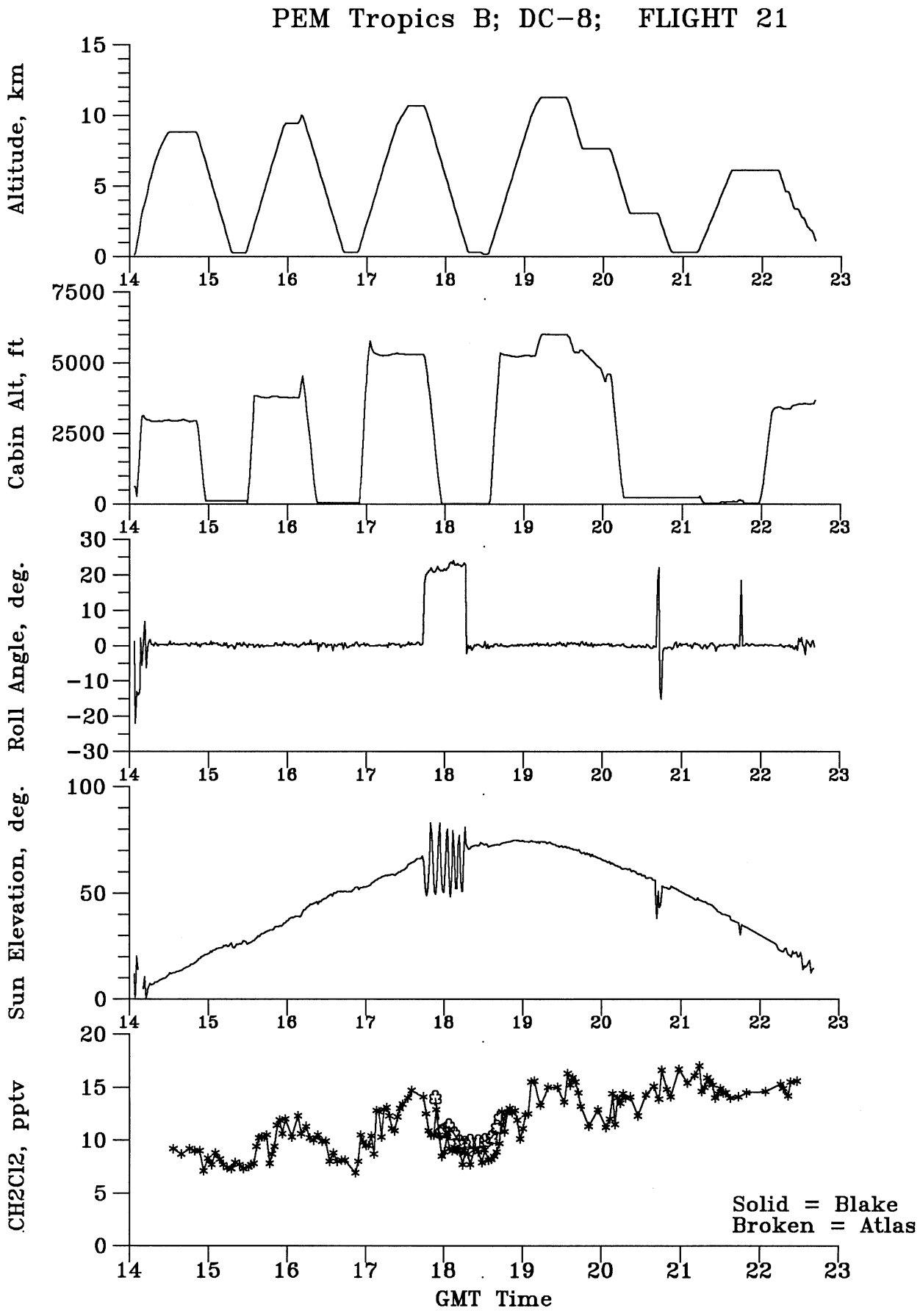

PEM Tropics B; DC-8; FLIGHT 21
H2O2, pptv
3000
2000
1000
0
CH3OOH & CH3COCH3, pptv
1200
1000
800
600
400
200
0
Solid - CH3OOH
Broken - CH3COCH3
HO2, pptv
50
40
30
20
10
0
BE7, fci/scm
1000
500
0
CH2O, pptv
1000
500
0
14
15
16
17
18
19
20
21
22
23
GMT Time


PEM Tropics B; DC-8; FLIGHT 21
NO3-, pptv
200
100
0
Cl-, pptv
5000
2500
0
CH3SO3-, pptv
24
12
0
SO4-, pptv
1500
1000
500
0
NH4+, pptv
1000
500
0
14
15
16
17
18
19
20
21
22
23
GMT Time

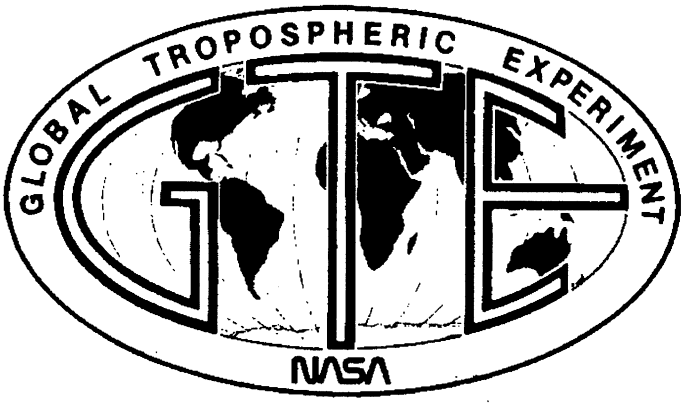

PEM Tropics B; DC-8; FLIGHT 21
CH3ONO2, pptv
Solid - Blake
Broken - Atlas
Square Singh
C2H5ONO2, pptv
Solid = Blake
Broken = Atlas
i-C3H7ONO2, pptv
Solid = Blake
Broken = Atlas
n-C3H7ONO2, pptv
Solid = Blake
Broken = Atlas
PAN, pptv
GMT Time


PEM Tropics B; DC-8; FLIGHT 21
CH3CFCl2, pptv
CH3CF2Cl, pptv
CHF2Cl, pptv
CH2Br2, pptv
CHBr3, pptv
Solid = Blake
Broken = Atlas
GMT Time


PEM Tropics B; DC-8; FLIGHT 21
J(O3), sec-1
2.0E-4
1.0E-4
0.0E+0
J(NO2), sec-1
3.0E-2
2.5E-2
2.0E-2
1.5E-2
1.0E-2
5.0E-3
0.0E+0
J(H2O2), sec-1
3E-5
2E-5
1E-5
0E+0
J(NO2)z, sec-1
2.0E-2
1.5E-2
1.0E-2
5.0E-3
0.0E+0
J(NO2)n, sec-1
2.0E-2
1.5E-2
1.0E-2
5.0E-3
0.0E+0
14 15 16 17 18 19 20 21 22 23
GMT Time


PEM Tropics B; DC-8; FLIGHT 21
Altitude, km
15
10
5
0
Cabin Alt, ft
7500
5000
2500
0
Roll Angle, deg.
30
20
10
0
-10
-20
-30
Sun Elevation, deg.
100
50
0
CH2Cl2, pptv
20
15
10
5
0
14
15
16
17
18
19
20
21
22
23
GMT Time
Solid = Blake
Broken = Atlas

PLOTS OF FINAL CHEMICAL DATA



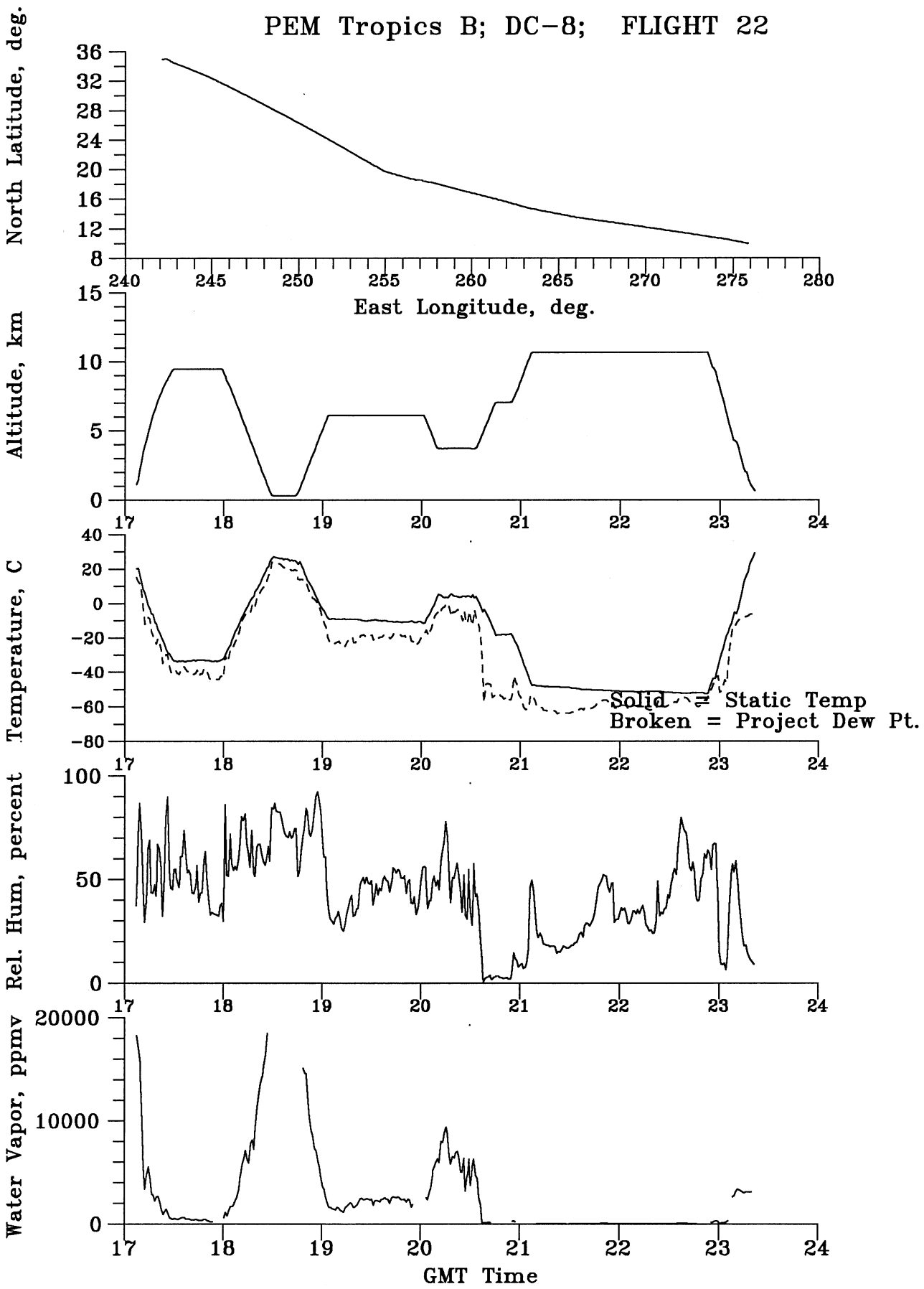
PEM-TROPICS B

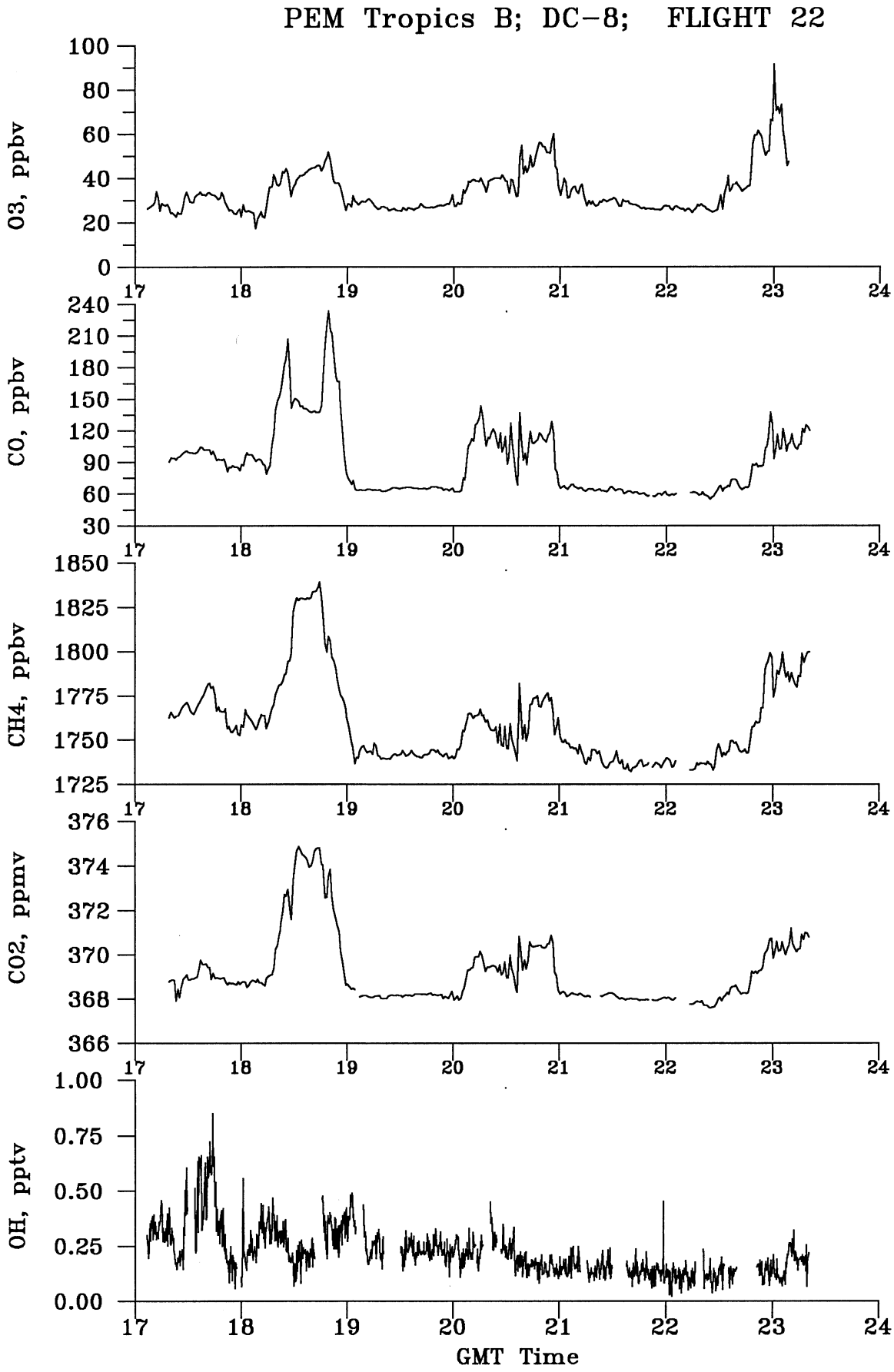
Flight 22D

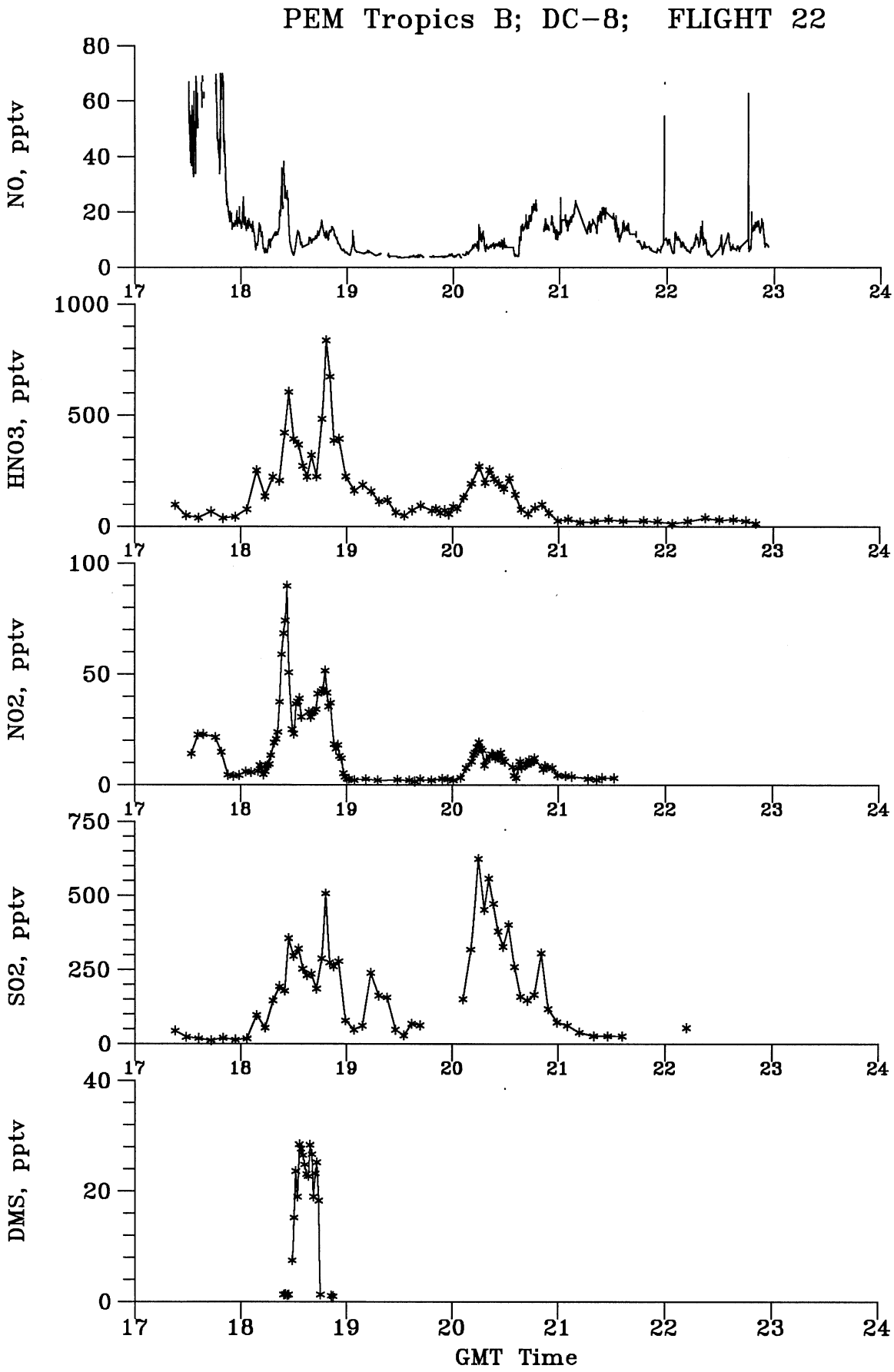
Transit: Costa Rica to NASA DFRC

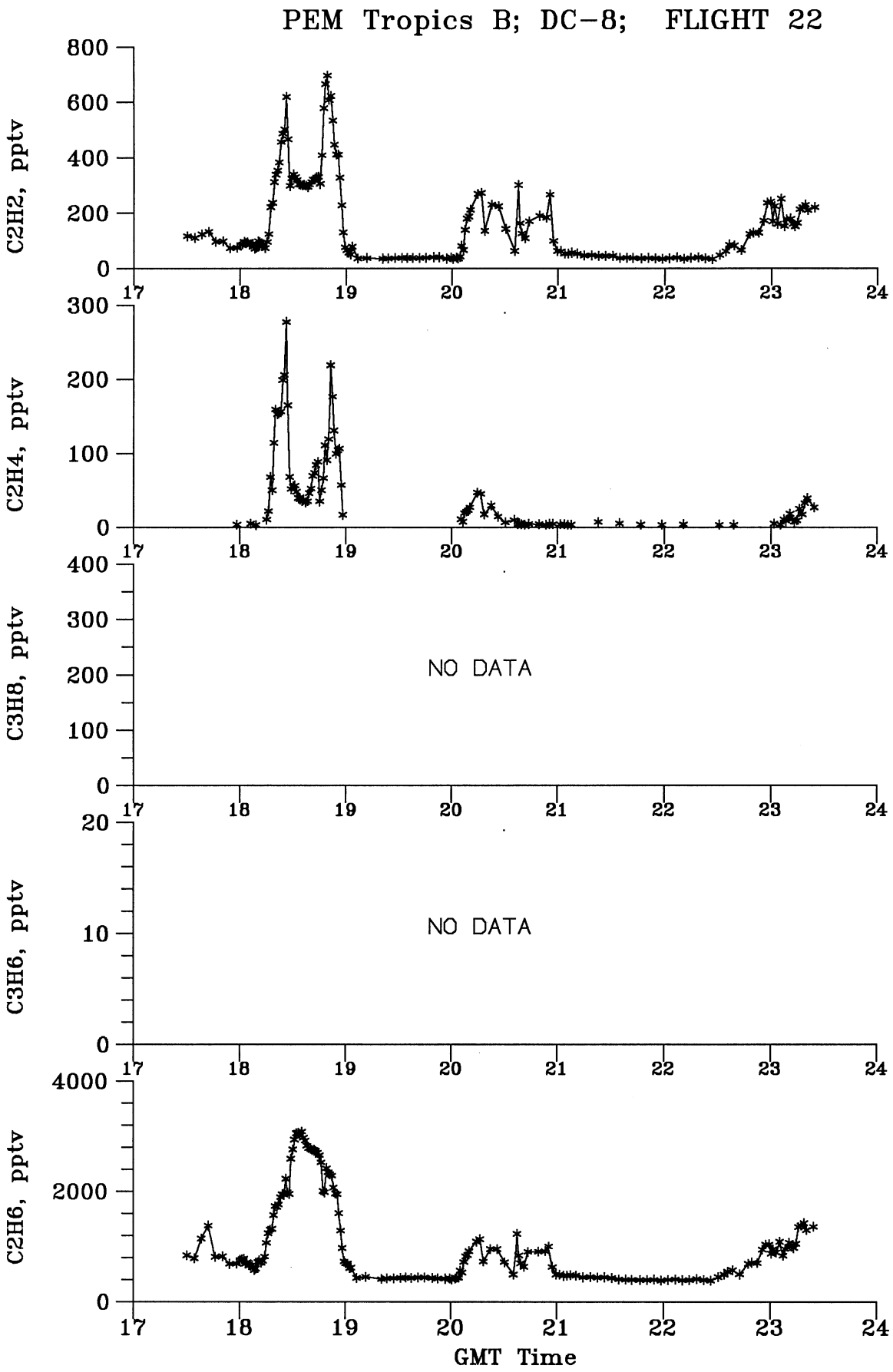
Central American Outflow

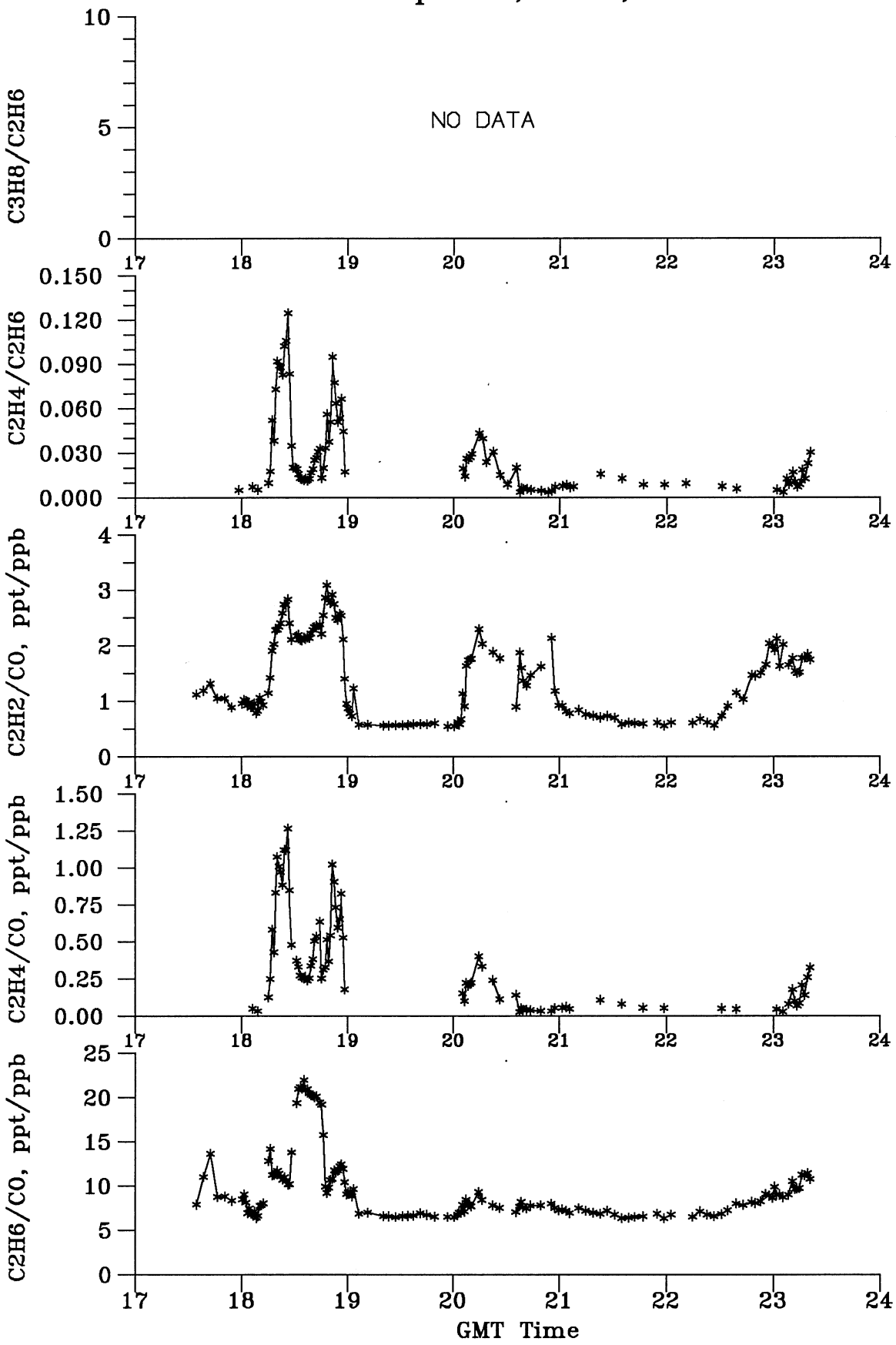
April 18, 1999

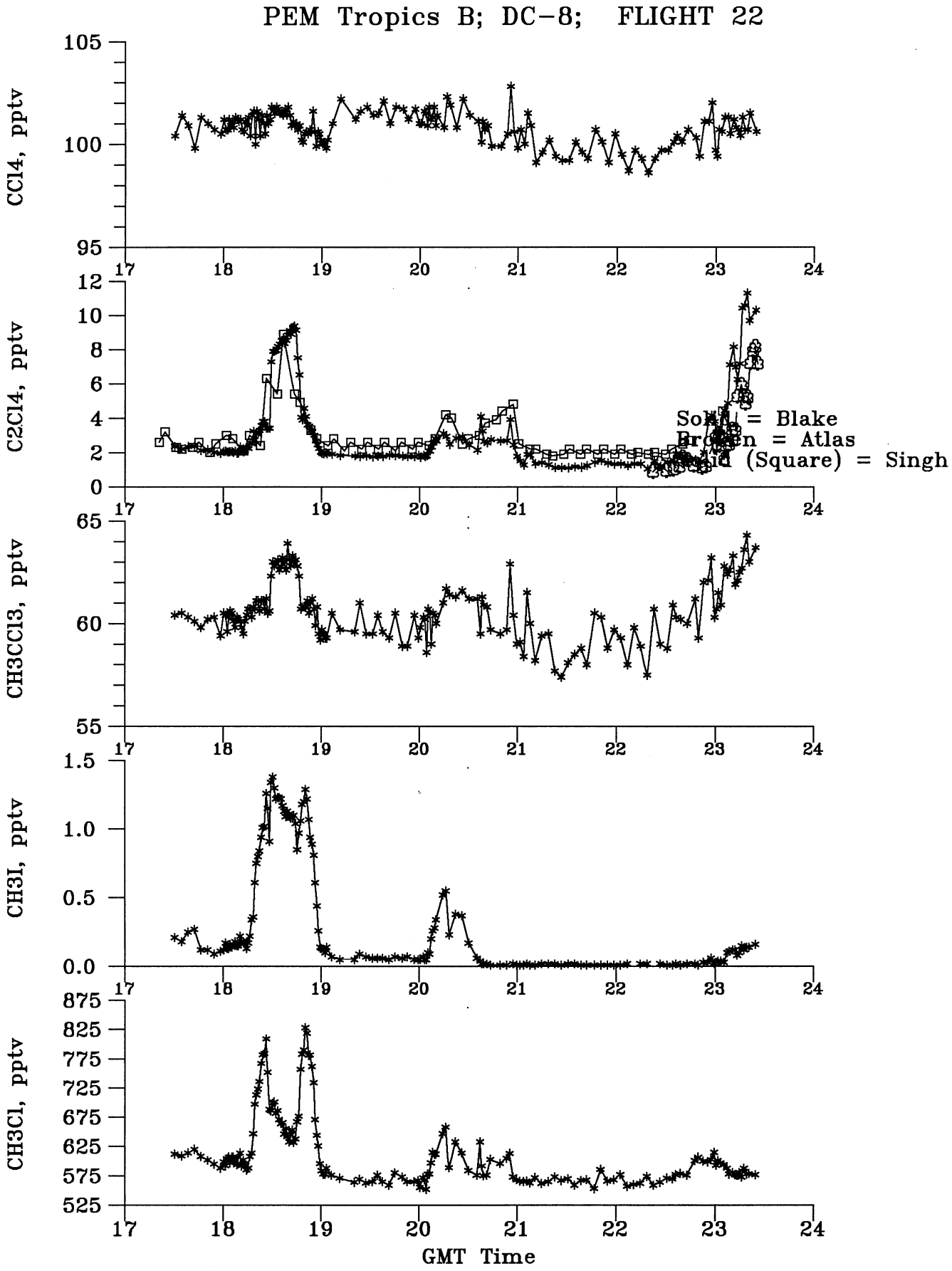

PEM Tropics B; DC-8; FLIGHT 22
North Latitude, deg.
36
32
28
24
20
16
12
8
240
245
250
255
260
265
270
275
280
East Longitude, deg.
Altitude, km
15
10
5
0
17
18
19
20
21
22
23
24
Temperature, C
40
20
0
-20
-40
-60
-80
Solid = Static Temp
Broken = Project Dew Pt.
Rel. Hum, percent
100
50
0
Water Vapor, ppmv
20000
10000
0
GMT Time

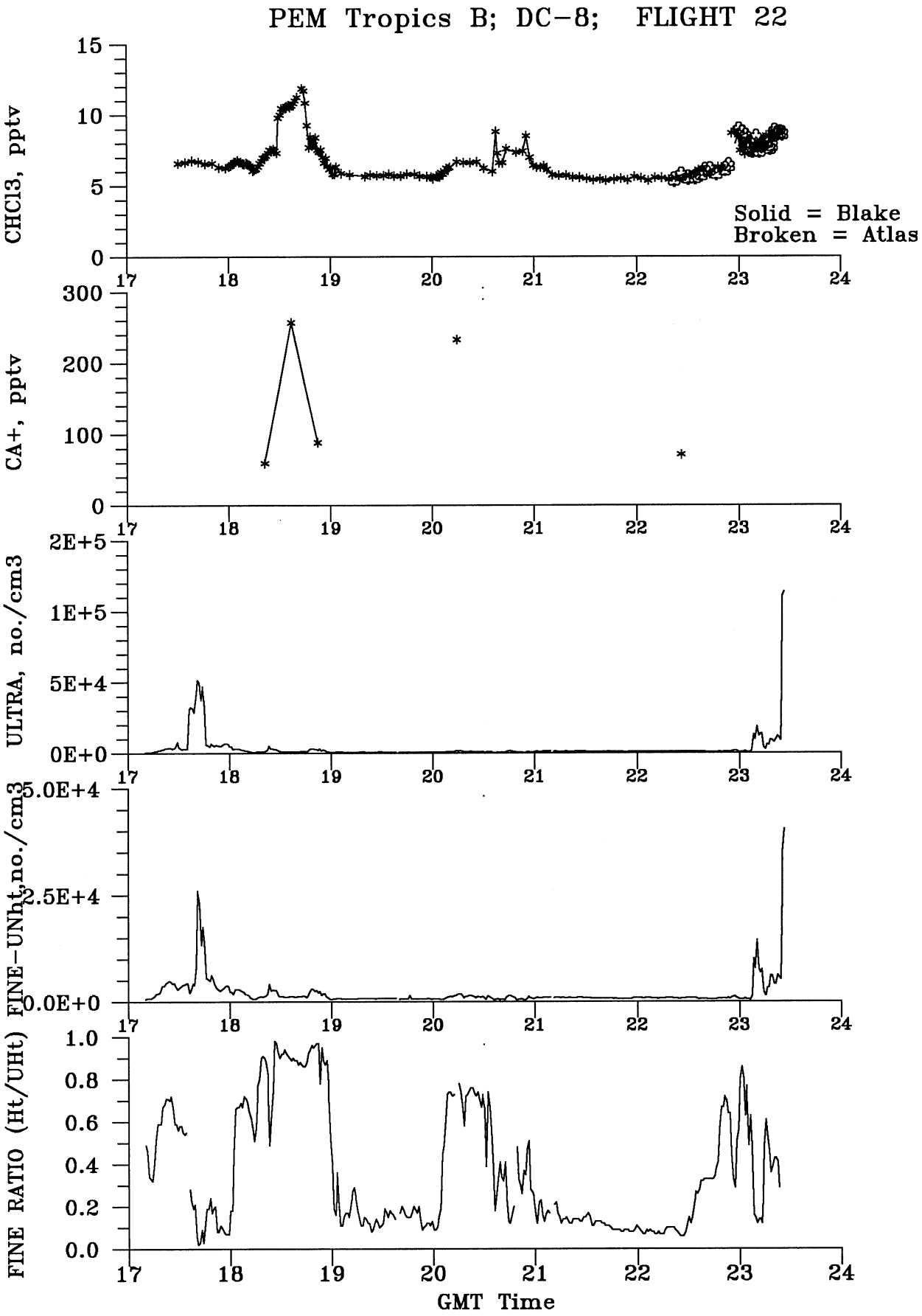

PEM Tropics B; DC-8; FLIGHT 22
O3, ppbv
100
80
60
40
20
0
CO, ppbv
240
210
180
150
120
90
60
30
CH4, ppbv
1850
1825
1800
1775
1750
1725
CO2, ppmv
376
374
372
370
368
366
OH, pptv
1.00
0.75
0.50
0.25
0.00
17
18
19
20
21
22
23
24
GMT Time

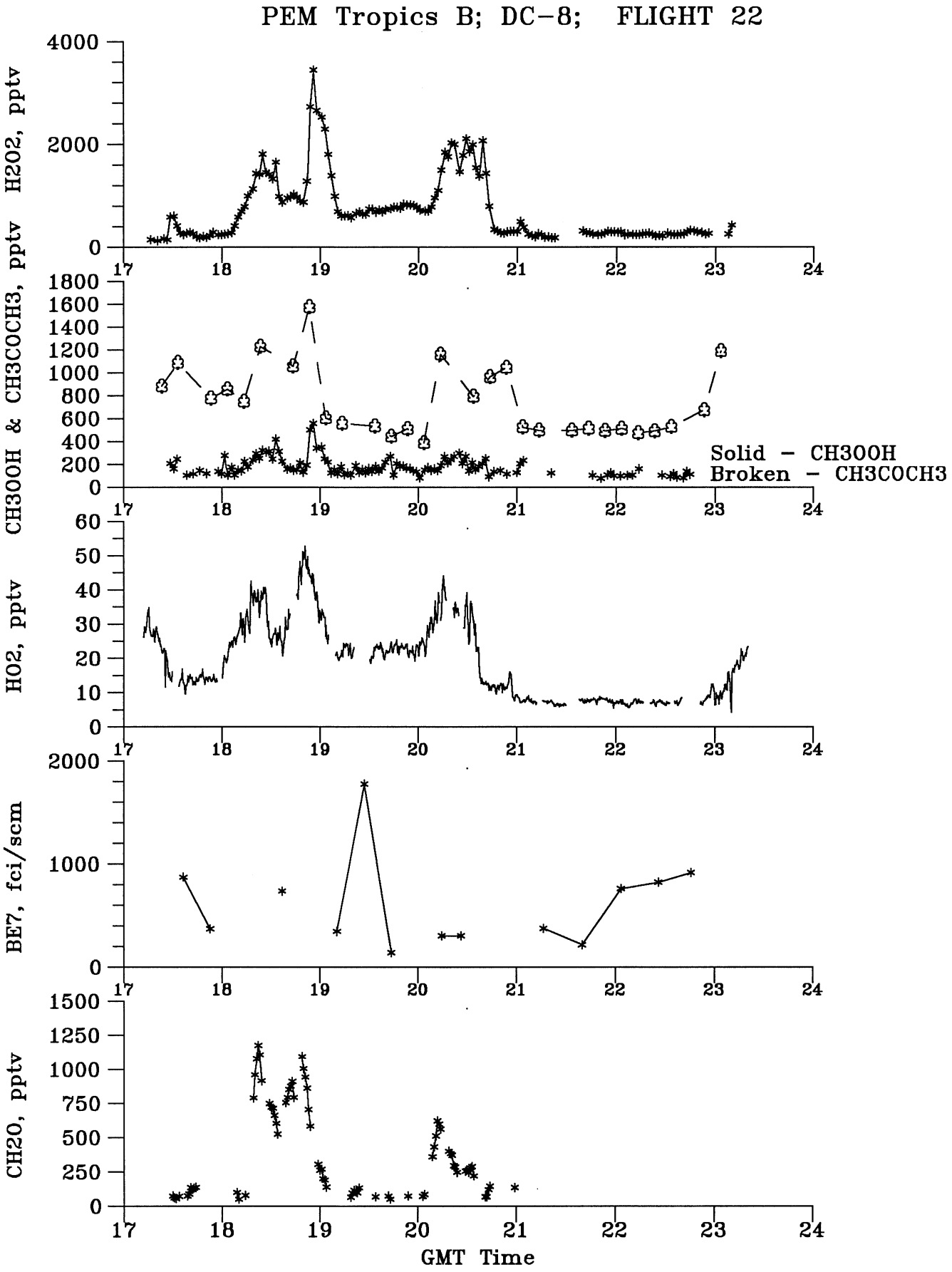

PEM Tropics B; DC-8; FLIGHT 22
NO, pptv
80
60
40
20
0
HNO3, pptv
1000
500
0
NO2, pptv
100
50
0
SO2, pptv
750
500
250
0
DMS, pptv
40
20
0
17
18
19
20
21
22
23
24
GMT Time

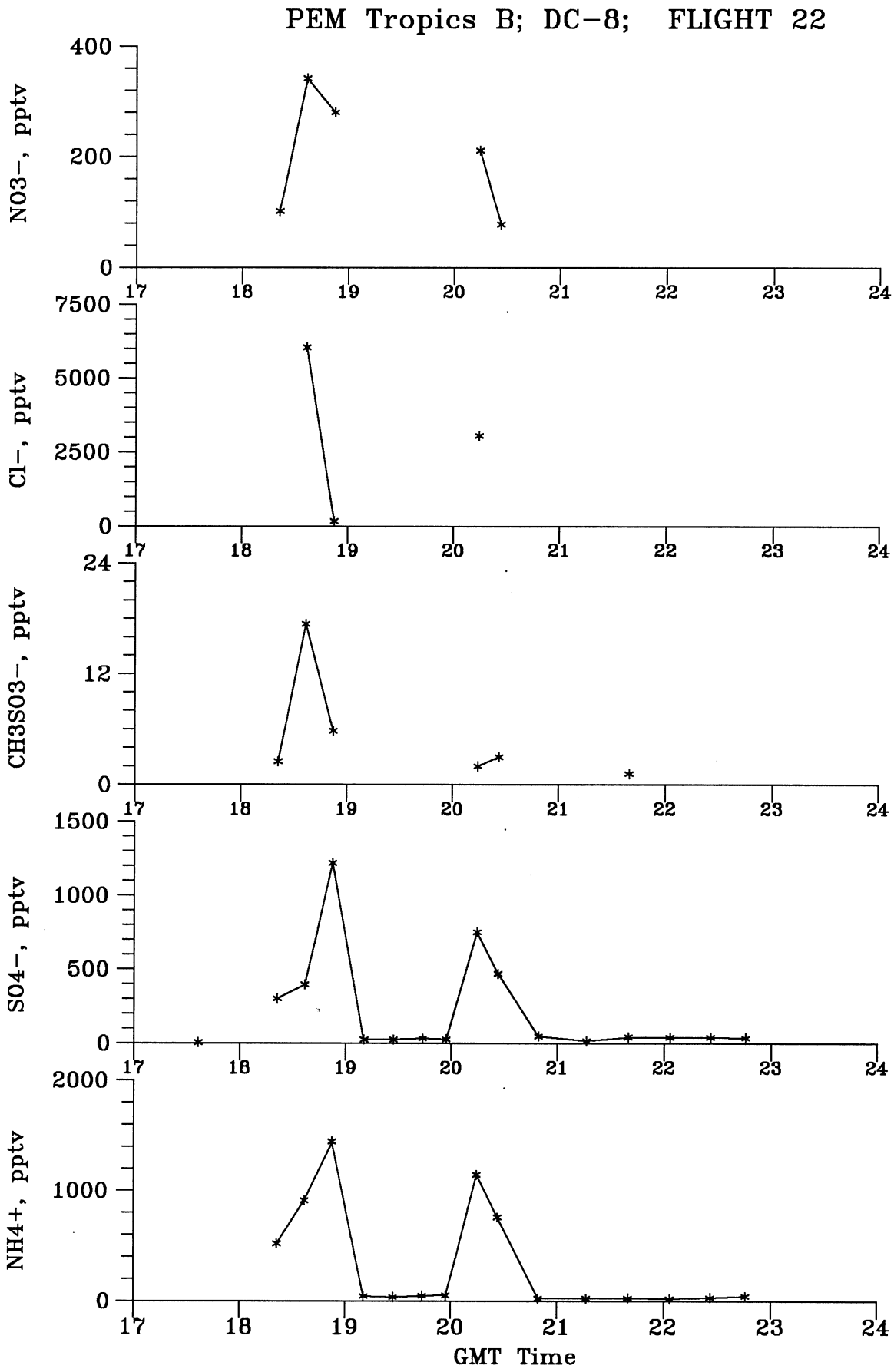

PEM Tropics B; DC-8; FLIGHT 22
C2H2, pptv
800
600
400
200
0
C2H4, pptv
300
200
100
0
C3H8, pptv
400
300
200
100
0
NO DATA
C3H6, pptv
20
10
0
NO DATA
C2H6, pptv
4000
2000
0
17
18
19
20
21
22
23
24
GMT Time

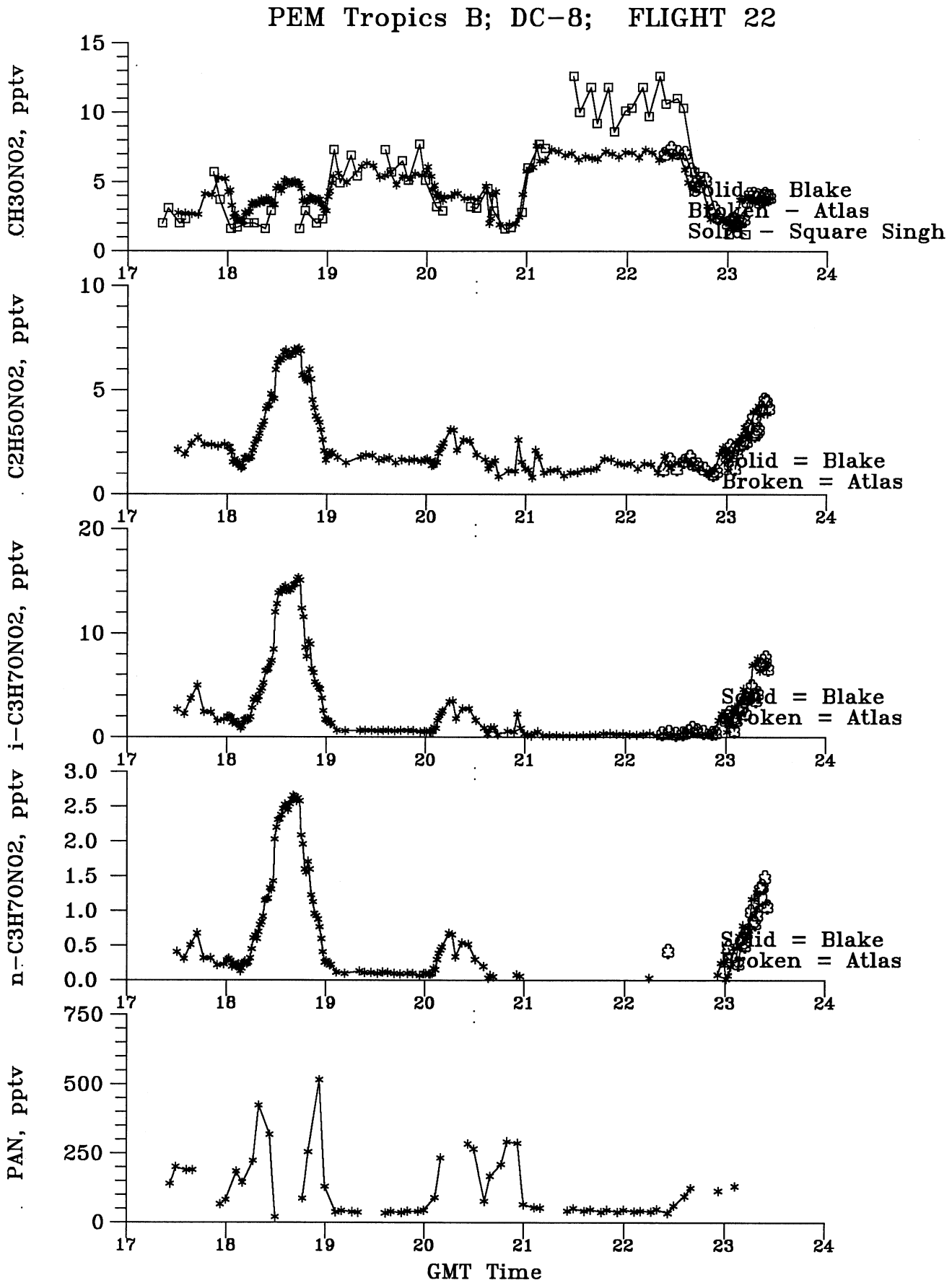

PEM Tropics B; DC-8; FLIGHT 22
C3H8/C2H6
NO DATA
C2H4/C2H6
C2H2/CO, ppt/ppb
C2H4/CO, ppt/ppb
C2H6/CO, ppt/ppb
GMT Time

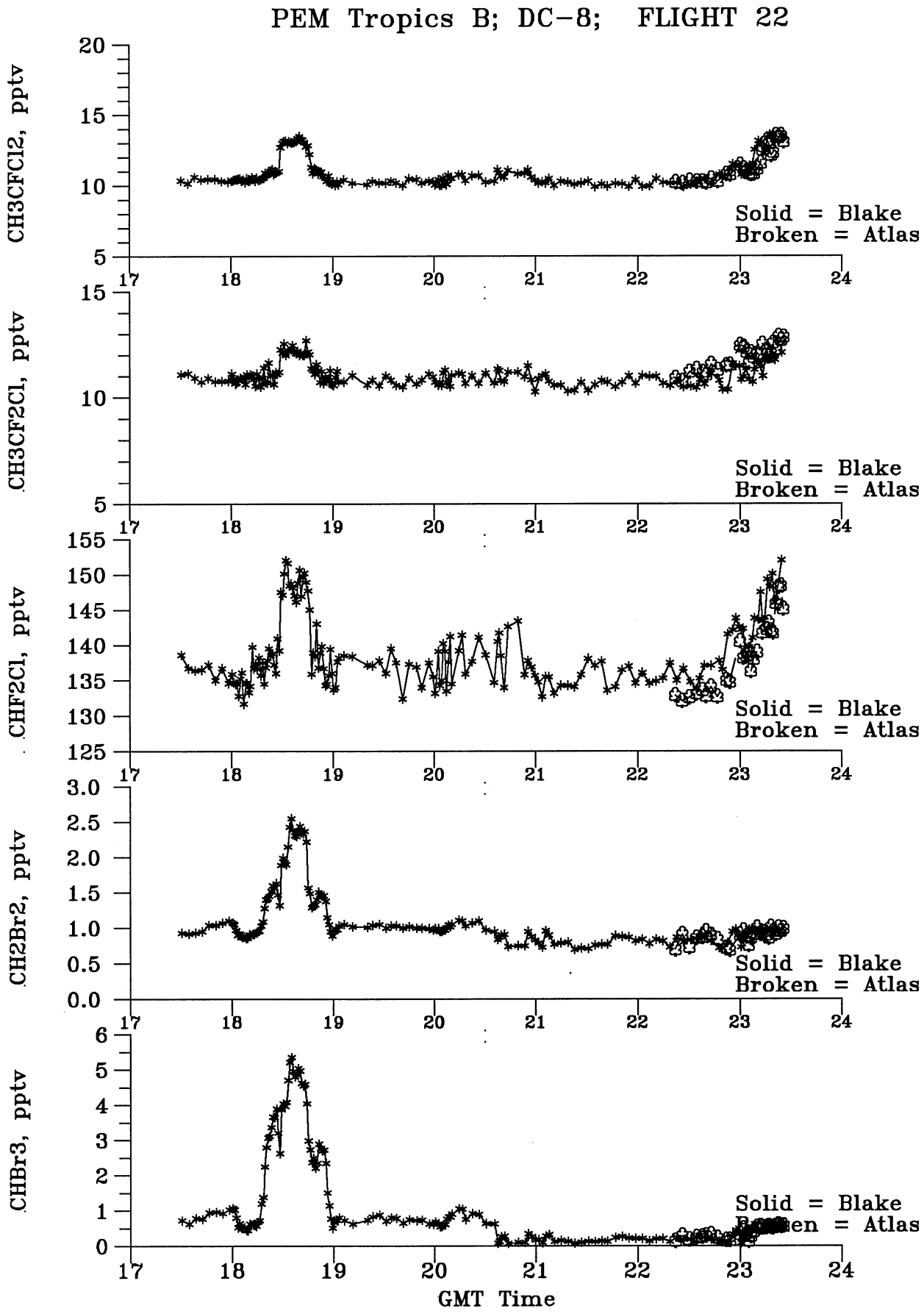

PEM Tropics B; DC-8; FLIGHT 22
CCl4, pptv
105
100
95
C2Cl4, pptv
12
10
8
6
4
2
0
Solid = Blake
Broken = Atlas
Solid (Square) = Singh
CH3CCl3, pptv
65
60
55
CH3I, pptv
1.5
1.0
0.5
0.0
CH3Cl, pptv
875
825
775
725
675
625
575
525
17
18
19
20
21
22
23
24
GMT Time

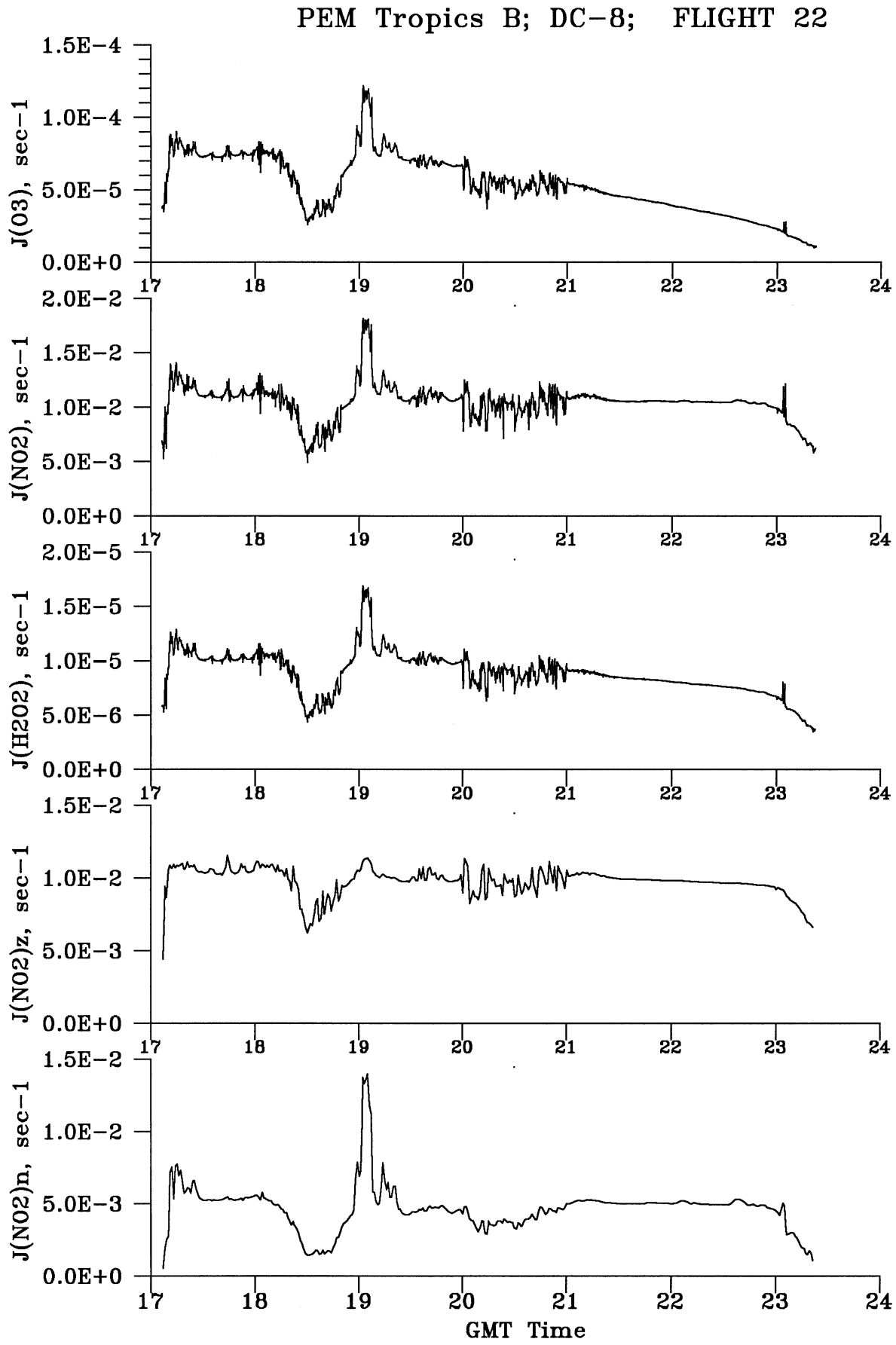

PEM Tropics B; DC-8; FLIGHT 22
CHCl3, pptv
Solid = Blake
Broken = Atlas
CA+, pptv
ULTRA, no./cm3
FINE-UNht, no./cm3
FINE RATIO (Ht/UHt)
GMT Time

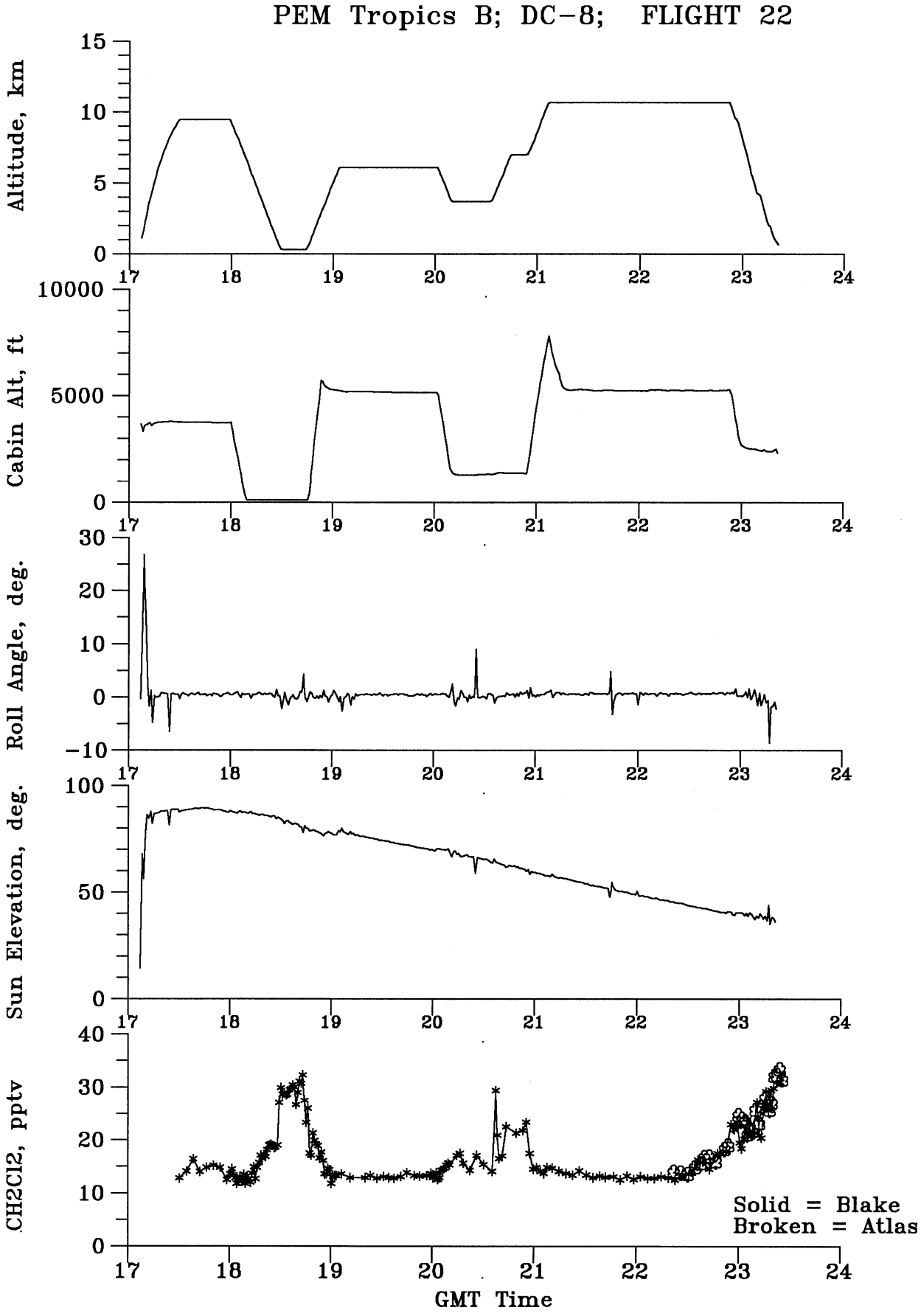

PEM Tropics B; DC-8; FLIGHT 22
H2O2, pptv
4000
2000
0
CH3OOH & CH3COCH3, pptv
1800
1600
1400
1200
1000
800
600
400
200
0
Solid - CH3OOH
Broken - CH3COCH3
HO2, pptv
60
50
40
30
20
10
0
BE7, fci/scm
2000
1000
0
CH2O, pptv
1500
1250
1000
750
500
250
0
17
18
19
20
21
22
23
24
GMT Time


PEM Tropics B; DC-8; FLIGHT 22
NO3-, pptv
400
200
0
Cl-, pptv
7500
5000
2500
0
CH3SO3-, pptv
24
12
0
SO4-, pptv
1500
1000
500
0
NH4+, pptv
2000
1000
0
17
18
19
20
21
22
23
24
GMT Time


PEM Tropics B; DC-8; FLIGHT 22
CH3ONO2, pptv
Solid = Blake
Broken = Atlas
Solid = Square Singh
C2H5ONO2, pptv
Solid = Blake
Broken = Atlas
i-C3H7ONO2, pptv
Solid = Blake
Broken = Atlas
n-C3H7ONO2, pptv
Solid = Blake
Broken = Atlas
PAN, pptv
GMT Time


PEM Tropics B; DC-8; FLIGHT 22
CH3CFCl2, pptv
CH3CF2Cl, pptv
CHF2Cl, pptv
CH2Br2, pptv
CHBr3, pptv
Solid = Blake
Broken = Atlas
GMT Time


PEM Tropics B; DC-8; FLIGHT 22
J(O3), sec-1
1.5E-4
1.0E-4
5.0E-5
0.0E+0
J(NO2), sec-1
2.0E-2
1.5E-2
1.0E-2
5.0E-3
0.0E+0
J(H2O2), sec-1
2.0E-5
1.5E-5
1.0E-5
5.0E-6
0.0E+0
J(NO2)z, sec-1
1.5E-2
1.0E-2
5.0E-3
0.0E+0
J(NO2)n, sec-1
1.5E-2
1.0E-2
5.0E-3
0.0E+0
17
18
19
20
21
22
23
24
GMT Time


PEM Tropics B; DC-8; FLIGHT 22
Altitude, km
15
10
5
0
Cabin Alt, ft
10000
5000
0
Roll Angle, deg.
30
20
10
0
-10
Sun Elevation, deg.
100
50
0
CH2Cl2, pptv
40
30
20
10
0
17
18
19
20
21
22
23
24
GMT Time
Solid = Blake
Broken = Atlas

APPENDIX B: LANGLEY DAAC DATA ARCHIVE

System Description

The Langley Distributed Active Archive Center (DAAC), located at the NASA Langley Research Center in Hampton, Virginia, is responsible for archiving and distributing NASA science data in the areas of radiation budget, clouds, aerosols, and tropospheric chemistry. This DAAC will also archive some on the data sets, which result from the EOS program and other elements of the Earth Science Enterprise. The DAAC has developed an on-line computer system, which allows the user to log on, search through the DAAC's data inventory, choose desired data sets, and place an order. Data may be received either electronically (via FTP) or on media such as 4mm tape, 8mm tape, or CD-ROM (prepackaged data sets only).

Log On Procedures

1. Users with an X-Windows terminal (e.g., Motif) or a Sun Open Windows display system with access to Internet, may log onto the system by entering:

   xhost + eosdis.larc.nasa.gov
   (or: xhost + 192.107.191.17)
   telnet eosdis.larc.nasa.gov
   login name: ims
   password: larcims

   At the prompts, enter x for the X-Windows interface and then your display name (name of your workstation followed by ":0" or internet address followed by ":0").

2. Users with access to Netscape or Microsoft Internet Explorer can use the following URL address:

   http://eosdis.larc.nasa.gov/

3. Users without access to a terminal with an X-Windows display system, but who have access to Internet may log onto the system by entering:

telnet eosdis.larc.nasa.gov
login name: ims
password: larcims

At the prompt, enter c for the character interface and then press return.

4. Users who cannot access the system or who have any questions concerning the Langley DAAC may contact:

Langley DAAC User and Data Services
Mail Stop 157D
NASA Langley Research Center
Hampton, VA 23681-0001
Phone: (757) 864-8656 (M-F 8 am – 8pm, Eastern Time)
FAX: (757) 864-8807
Email: larc@eos.nasa.gov

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	December 2000	Technical Memorandum

4. TITLE AND SUBTITLE
Compendium of NASA Data Base for the Global Tropospheric Experiment's Pacific Exploratory Mission-Tropics B (PEM-Tropics B) - Volume 1: DC-8

5. FUNDING NUMBERS
WU 622-63-06-70

6. AUTHOR(S)
A. Donald Scott, Jr., Mary M. Kleb, and James L. Raper

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
NASA Langley Research Center
Hampton, VA 23681-2199

8. PERFORMING ORGANIZATION REPORT NUMBER
L-18042A

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
National Aeronautics and Space Administration
Washington, DC 20546-0001

10. SPONSORING/MONITORING AGENCY REPORT NUMBER
NASA/TM-2000-210617/VOL1

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT
Unclassified-Unlimited
Subject Category 42 Distribution: Standard
Availability: NASA CASI (301) 621-0390

12b. DISTRIBUTION CODE

13. ABSTRACT (Maximum 200 words)
This report provides a compendium of NASA aircraft data that are available from NASA's Global Tropospheric Experiment's (GTE) Pacific Exploratory Mission-Tropics B (PEM-Tropics B) conducted in March and April 1999. PEM-Tropics B was conducted during the southern-tropical wet season when the influence from biomass burning observed in PEM-Tropics A was minimal. Major deployment sites were Hawaii, Kiritimati (Christmas Island), Tahiti, Fiji, and Easter Island. The broad goals of PEM-Tropics B were to improved understanding of the oxidizing power of the atmosphere and the processes controlling sulfur aerosol formation and to establish baseline values for chemical species that are directly coupled to the oxidizing power and aerosol loading of the troposphere. The purpose of this document is to provide a representation of aircraft data that will be available in archived format via NASA Langley's Distributed Active Archive Center (DAAC) or are available through the GTE Project Office archive. The data format is not intended to support original research/analysis, but to assist the reader in identifying data that are of interest.

14. SUBJECT TERMS
Tropospheric chemical composition; Aircraft tropospheric measurements

15. NUMBER OF PAGES
290

16. PRICE CODE
A13

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	UL