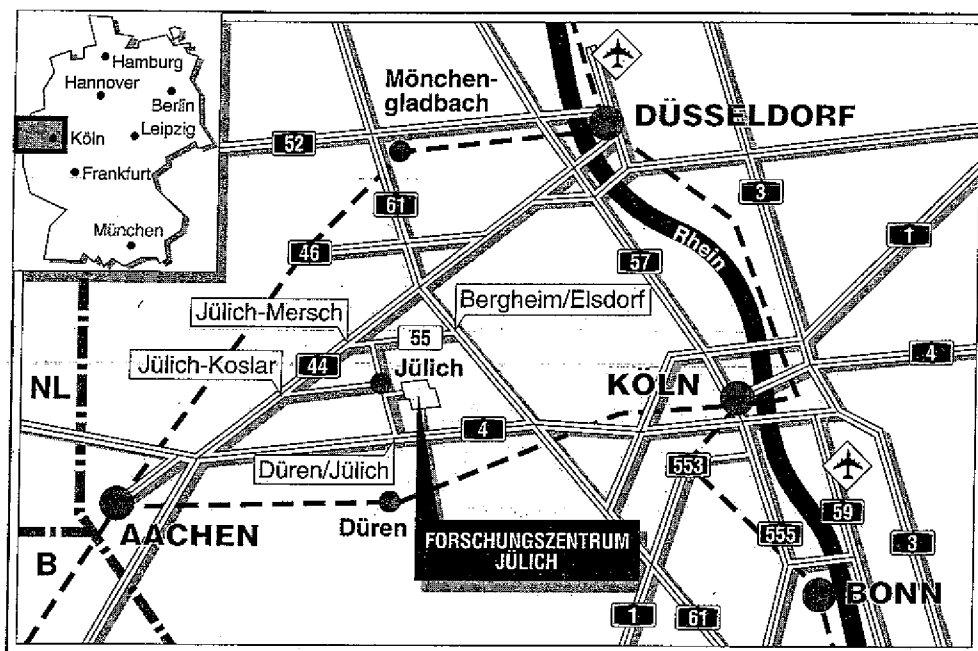


*Institut für Chemie 2:
Chemie der Belasteten Atmosphäre*

**Ozone profiles over the Atlantic
Ocean between 36° S and 52° N
in March/April 1987 and
September/October 1988**

H.G.J. Smit S. Gilge D. Kley



Berichte des Forschungszentrums Jülich ; 2567

ISSN 0366-0885

Institut für Chemie 2: Chemie der Belasteten Atmosphäre Jül-2567

Zu beziehen durch: Forschungszentrum Jülich GmbH · Zentralbibliothek
Postfach 1913 · D-5170 Jülich · Bundesrepublik Deutschland
Telefon: 02461/61-6102 · Telefax: 02461/61-6103 · Telex: 833556-70 kfa d

**Ozone profiles over the Atlantic
Ocean between 36° S and 52° N
in March/April 1987 and
September/October 1988**

H.G.J. Smit S. Gilge D. Kley

Table of contents

	Page
Summary	1
1. Introduction	2
2. Vertical Ozone Profiles	4
References	6
 Meridional distributions of ozone and water vapor in March/April 1987 and September/October 1988	 7
 Individual vertical profiles	 9
during March/April 1987 (ANT-V/5)	10
during September/October (ANT-VII/1)	66

Summary

Vertical ozone soundings were performed during two scientific shipcruises, ANT-V/5 and ANT-VII/1, of the research vessel "Polarstern" over the Atlantic Ocean between 30 °S and 52 °N in March/April 1987 and September/October 1988, respectively. Vertical profiles of ozone and meteorological parameters like pressure, temperature and relative humidity were measured at different latitudes to obtain meridional distributions of tropospheric/lower stratospheric ozone and water vapor during two different seasons. In this volume we will report the results of the individual soundings and the derived meridional distributions of ozone and water vapor measured during the two cruises.

1. Introduction

Although tropospheric ozone plays an important role in tropospheric chemistry as a precursor for reactive radicals and as a significant absorber of infrared radiation, little is known about its distribution with respect to altitude and latitude. Ozone is most frequently measured at or very close to the surface. In fact, there are hundreds of ground-based monitoring stations in the northern hemisphere (NH) and in the southern hemisphere (SH), which are mainly located over the continents. Vertical profiles of ozone have mostly been obtained at stations that use electrochemical ozone sondes. Traditionally, their principal purpose is to measure stratospheric ozone. In central Europe the most well known station is at the Hohenpeissenberg, FRG [Attmanspacher et al.(1984)]. Only a few stations operate in the southern hemisphere [Oltmans et al., (1989)].

There is a particular dearth of information on the maritime distribution of tropospheric ozone over the Atlantic Ocean. It is of importance to know the height resolved concentration of tropospheric ozone as the air masses approach the European continent with the prevailing winds coming from the West and, finally, from the polluted regions of the American continent. This information is important for two reasons: First, the ozone pollution over Europe can only be assessed by knowing the ozone concentration of the incoming air and, secondly, Eulerian numerical model studies must have proper boundary conditions.

Further, the simultaneous measurement of ozone and water vapor enable us to investigate the meridional distributions of ozone in terms of large scale transport and photochemical processes of ozone in the northern as well as in the southern hemisphere.

In this volume we will present the results from the individual vertical soundings of ozone and the meteorological parameters like pressure, temperature and relative humidity obtained during two ship cruises over the Atlantic Ocean between 30°S and 52°N mostly along the 30°W meridian. We will also present the meridional distribution of ozone and watervapor, derived from the individual vertical profiles.

These meridional distributions have been discussed in detail in two scientific reports [Smit et al.,(1989-A, 1990)]. The ozone sounding system, instrumental set up and data processing has been described in the first volume of these series [Smit et al.(1989-B)].

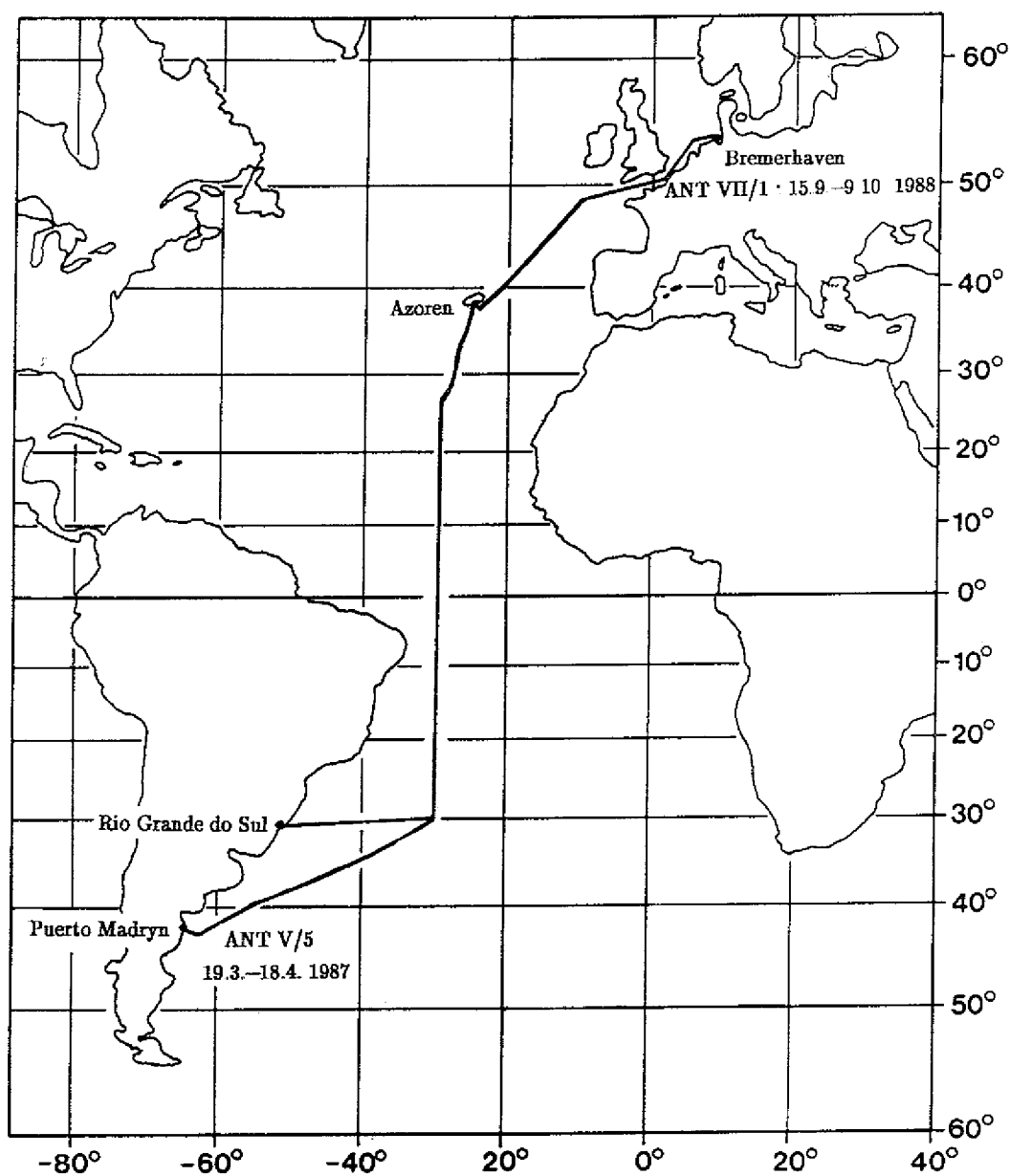


Figure 1: Cruise track of FS "Polarstern" during ANT-V/5 (March/April 1987) from Puerto Madryn to Bremerhaven and ANT-VII/1 (September/October 1988) from Bremerhaven to Rio Grande do Sul

2. Vertical Ozone profiles

The vertical soundings were made aboard the German research vessel "Polarstern", operated by the Alfred Wegener Institute, Bremerhaven during two scientific shipcruises over the Atlantic Ocean. Figure 1 shows the tracks of both cruises. The first cruise took place from Puerto Madryn (42°S), Argentina to Bremerhaven (53°N), Germany between March 19 and April 18, 1987. Totally 25 flights were performed with a latitudinal spacing of about 3–4 degrees. Three flights were twin soundings, in which two ozone sondes were flown simultaneously on the same gondola. The second cruise was during another season of the year from Bremerhaven to Rio Grande do Sul (32°S), Brazil between September 15 and October 9, 1988. All together 40 soundings were made with a latitudinal spacing of 1.5–2.5 degrees.

The results of the soundings performed during the two cruises are presented in the form of individual vertical profiles of ozone and the simultaneously measured meteorological parameters like pressure, temperature and relative humidity. For every flight two plots are presented. The first plot shows the complete profile during ascent up to the burst altitude of the balloon. This plot gives a standard ozonogram with the partial pressure of ozone (mPa), temperature ($^{\circ}\text{C}$) and relative humidity (%) on the abscissa as a function of pressure (hPa) on a logarithmic scale. The second plot presents the tropospheric part of the individual soundings in greater detail. Here, we use units of mixing ratio (ppbv) for ozone on the abscissa as a function of geometric altitude (km) where the altitude was computed step by step as the cumulative sum of the height difference between two successive pressure levels using the hydrostatic equation.

The meridional distributions of tropospheric ozone and water vapor derived from the individual vertical profiles was determined by the following procedure:

First, the individual vertical profiles of the different measured parameters like ozone and the meteorological parameters (pressure, temperature and relative humidity) were made equidistant with a vertical spacing of 250 m by calculating the weighted mean over the different height intervals.

Secondly, the resulting equidistant vertical profiles, obtained at different latitudes, are concatenated for each measured parameter to a data set representing their meridional distributions. From this data set the meridional distributions of the volume mixing ratio of ozone and water vapor were determined. The meridional distributions are presented by isolines of mixing ratio as well as colouring the regions of the different data points to

a color coded table of different mixing ratios. The isolines were calculated after the data set was also made equidistant in latitudinal direction with a spacing of one degree by linear interpolation and additionally a low pass filter was used to smooth structures with length scales smaller than 500m altitude and 2 degree latitude. Regions of missing observations are non coloured and the isolines are interpolated, indicated by dashed lines.

Tropopause heights were determined following the WMO-standard, while the actual location of the inter tropical convergence zone (ITCZ) was determined from synoptic observations.

Acknowledgement

We thank the Alfred Wegener Institute in Bremerhaven, FRG, for the opportunity to participate in the ANT-V/5 and ANT-VII/1 expedition aboard the FS "Polarstern". Also, we want to thank the crews aboard the ship for their assistance during both cruises.

We thank Mr. O. Heißenbüttel and Mrs. C. Sohnemann for writing the graphics program.

References

- Attmannspacher, W., R. Hartmannsgruber, and P. Lang,
Long period tendencies of atmospheric ozone based on ozone measurements started in
1967 at the Hohenpeissenberg Meteorological Observatory.
Meteorol. Rdsch., 37, 193–199 (1984).
- Oltmans, S.J., W.D. Komhyr, P.R. Franchois, and W.A. Matthews,
Tropospheric ozone: variations from surface and ECC ozonesonde observations, in: R.D.
Bojkov, P. Fabian (eds), *Ozone in the Atmosphere*, p.539–543, Deepak Publ., (1989)
- Smit, H.G.J., D. Kley, S. McKeen, A. Volz, and S. Gilge, The latitudinal and vertical
distribution of tropospheric ozone over the Atlantic Ocean in the southern and northern
hemispheres, in: R.D. Bojkov, P. Fabian (eds), *Ozone in the Atmosphere*, p.419–422,
Deepak Publ., (1989–A)
- Smit, H.G.J. Smit, W. Sträter, H. Loup, and D. Kley, Ozone profiles at Jülich, FRG,
during 1988 and 1989, *Jül Berichte Nr 2337*, Forschungszentrum Jülich, (1989–B)
- Smit, H.G.J., S. Gilge, and D. Kley, The meridional distribution of ozone and water
vapor over the Atlantic Ocean between 30° S and 52° N in September/October 1988, in
G. Restelli, G. Angeletti (eds.), *Physico-chemical behaviour of atmospheric pollutants*,
CEC., Air Pollution Report 23, p.630–637, Kluwer Acad. Publ., (1990)

**Meridional distributions of ozone and water vapor
in March/April 1987 and September/October 1988**

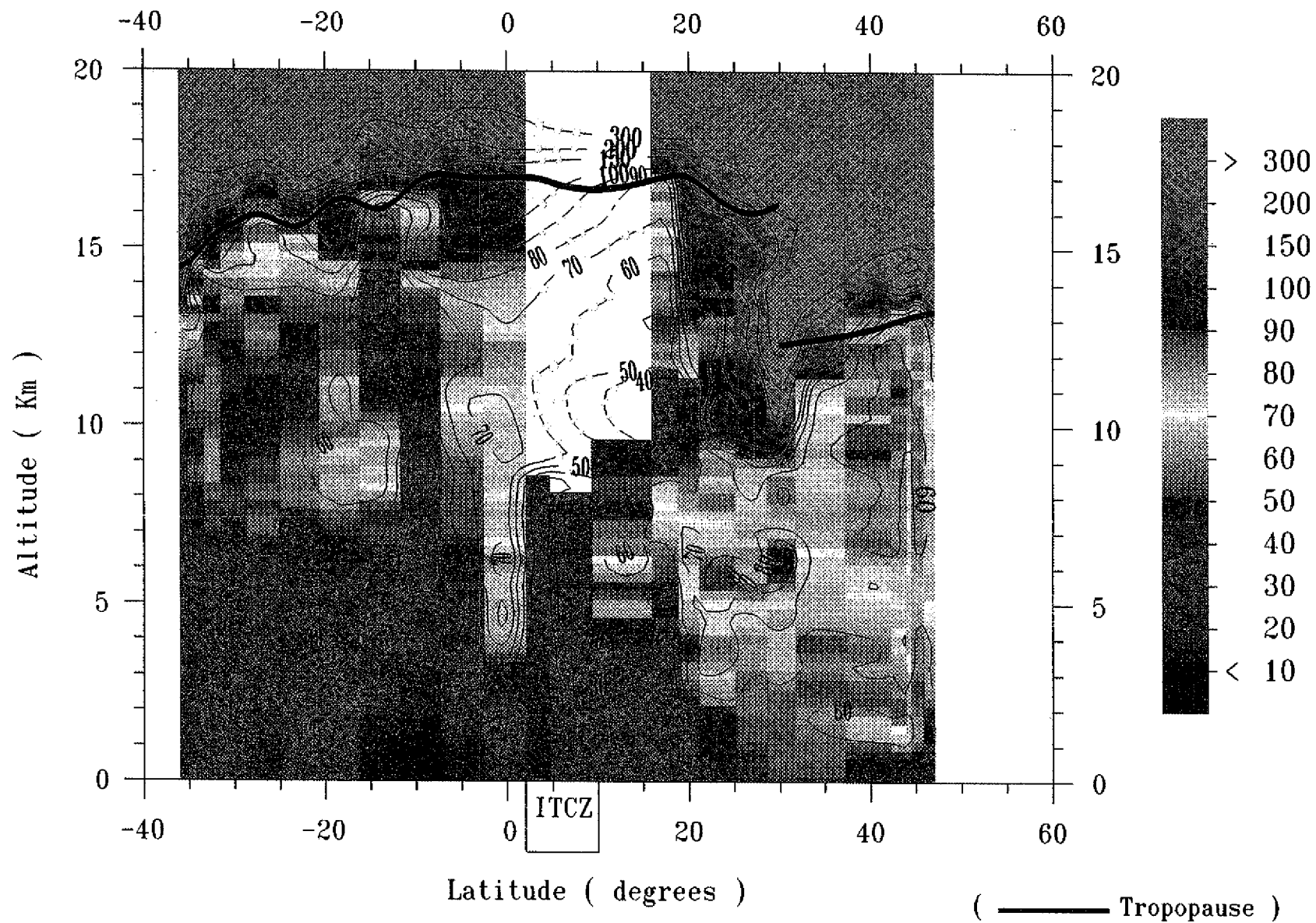
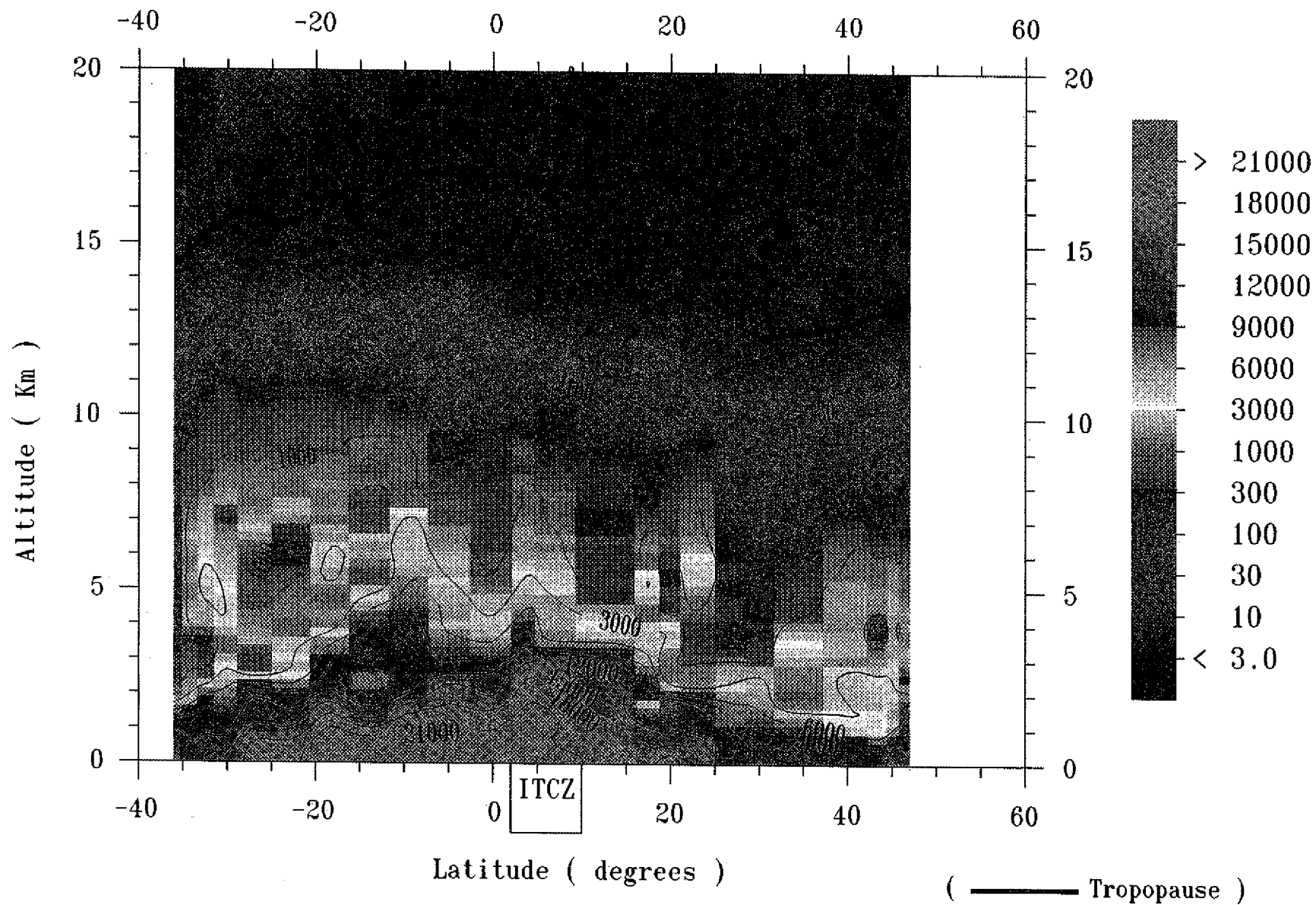
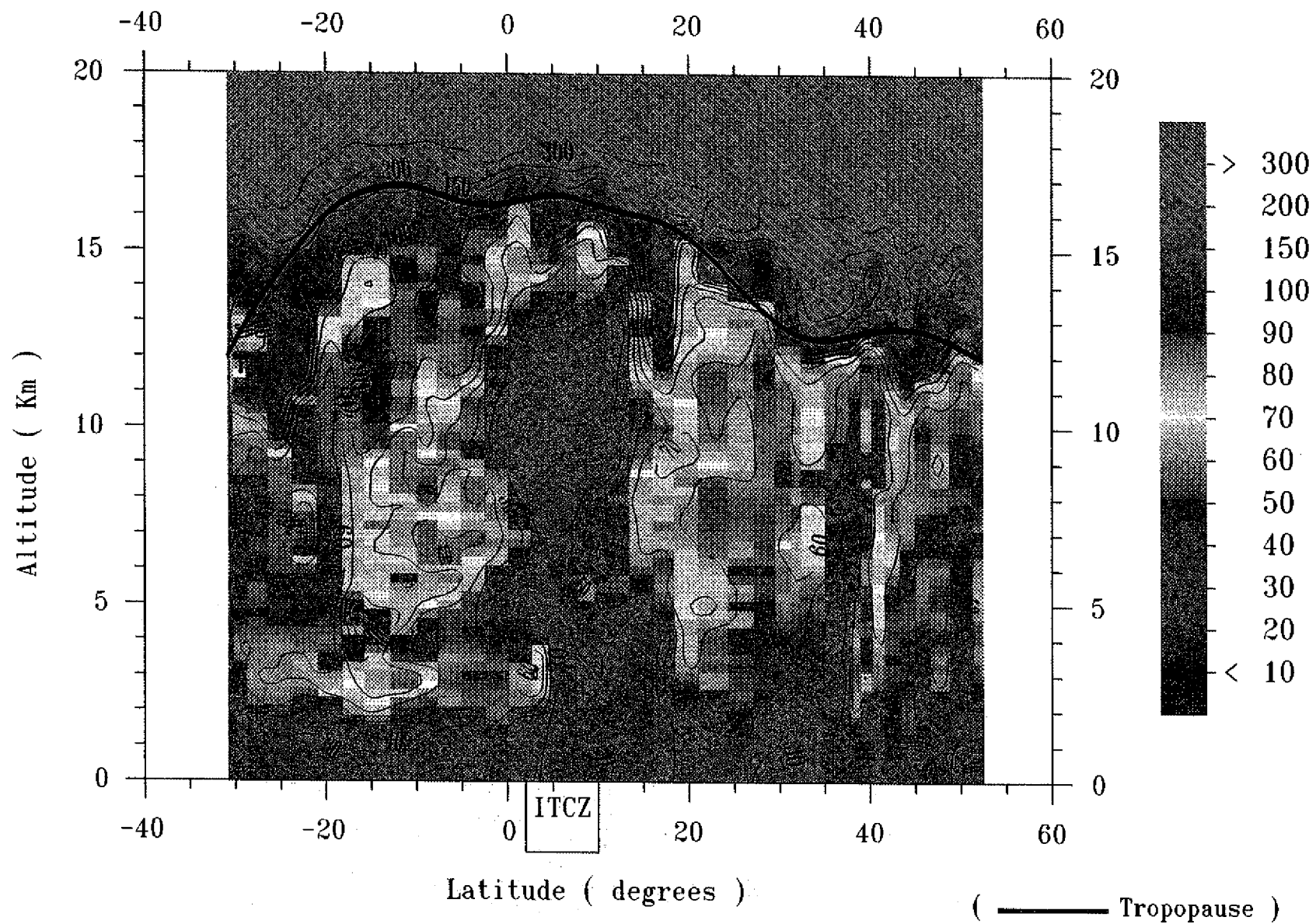


Figure 2 : Meridional distribution of Ozone (mixing ratio in ppbv)
over Mid-Atlantic Ocean in March/April 1987



8-B

Figure 3 : Meridional distribution of Water vapor (mixing ratio in ppmv)
over Mid-Atlantic Ocean in March/April 1987



0-8

Figure 4 : Meridional distribution of Ozone (mixing ratio in ppbv)
over Mid-Atlantic Ocean in September/October 1988

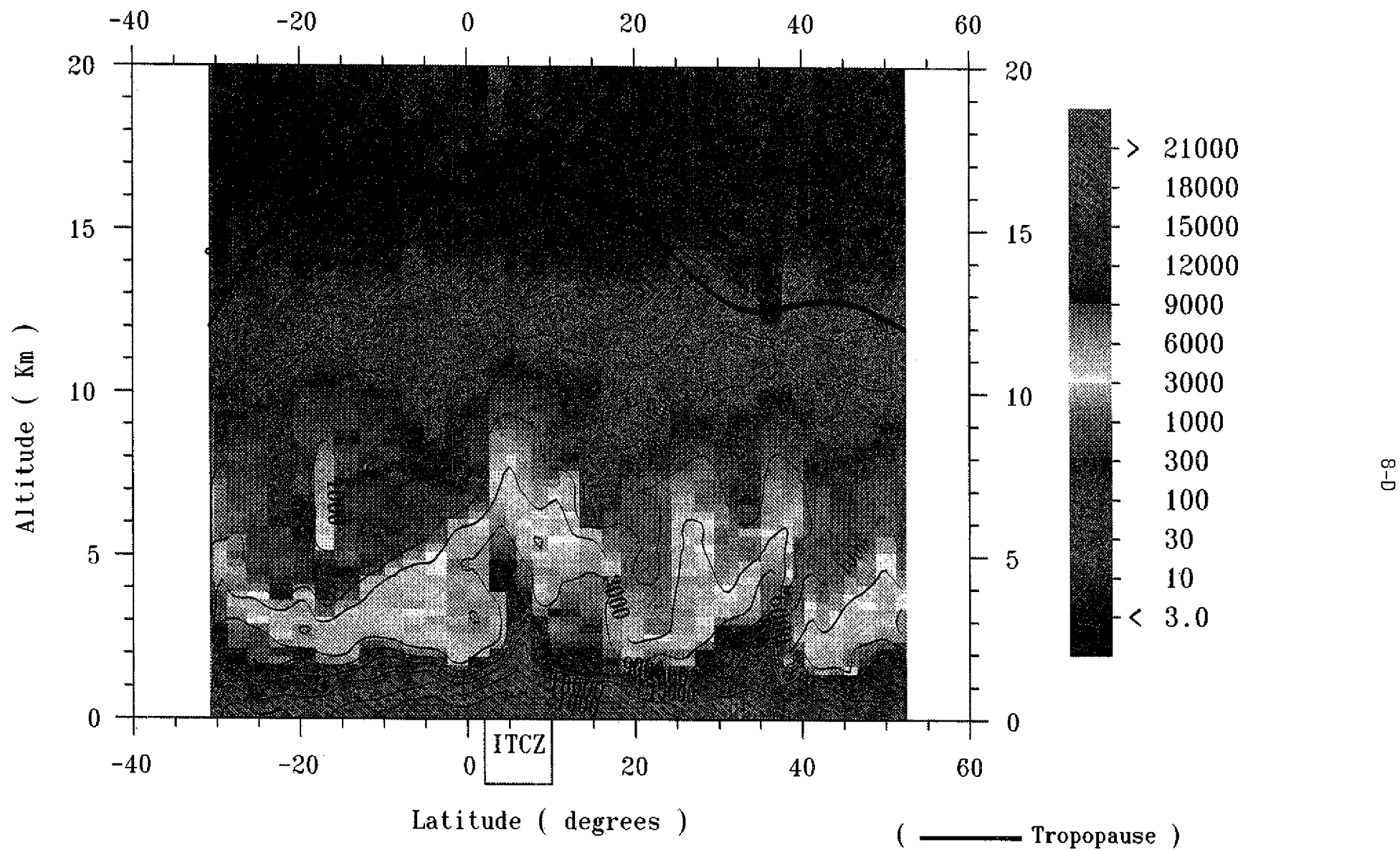


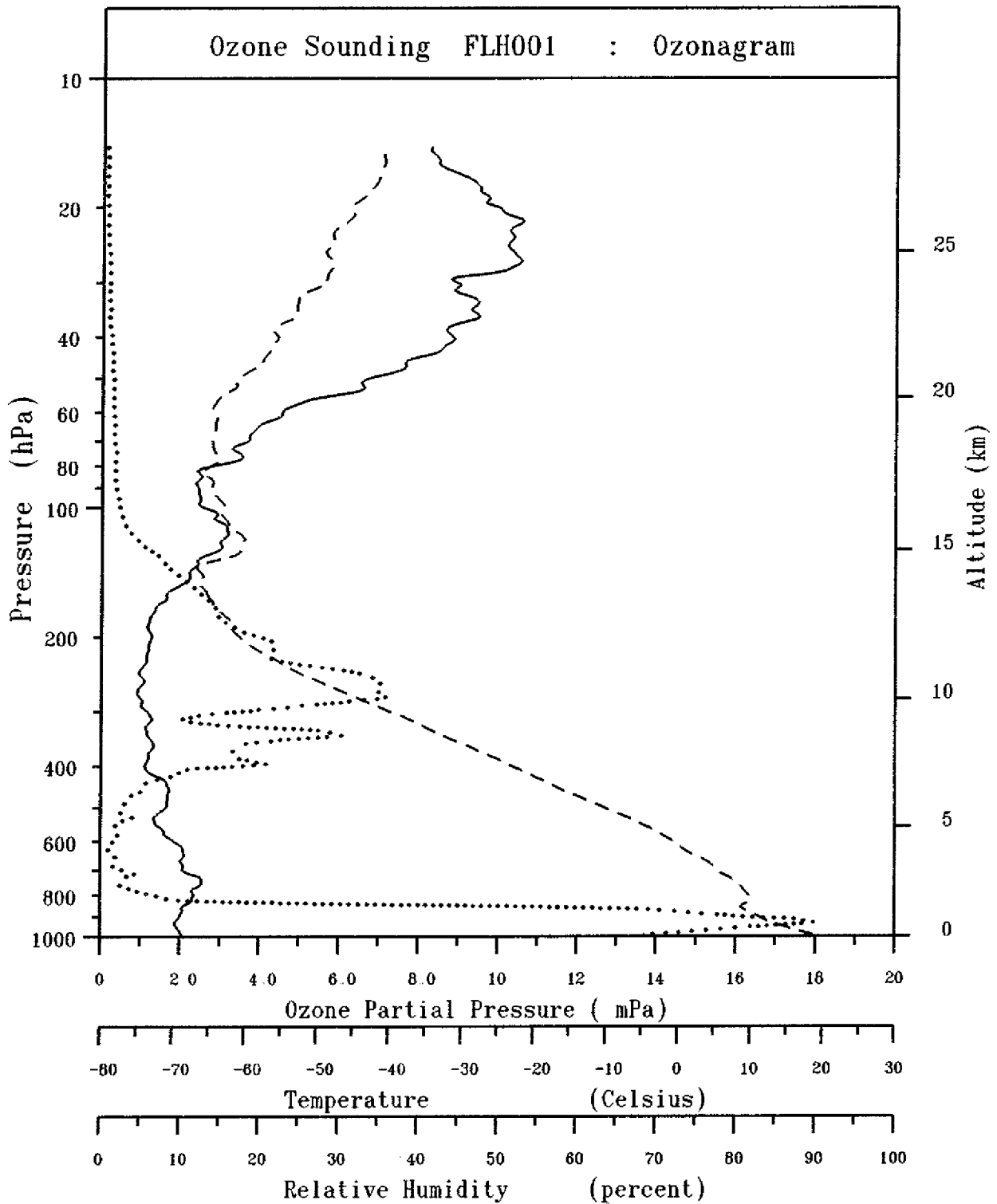
Figure 5 : Meridional distribution of Water vapor (mixing ratio in ppmv)
over Mid-Atlantic Ocean in September/October 1988

**Individual vertical profiles during March/April 1987 (ANT-V/5)
and September/October 1988 (ANT-VII/1)**

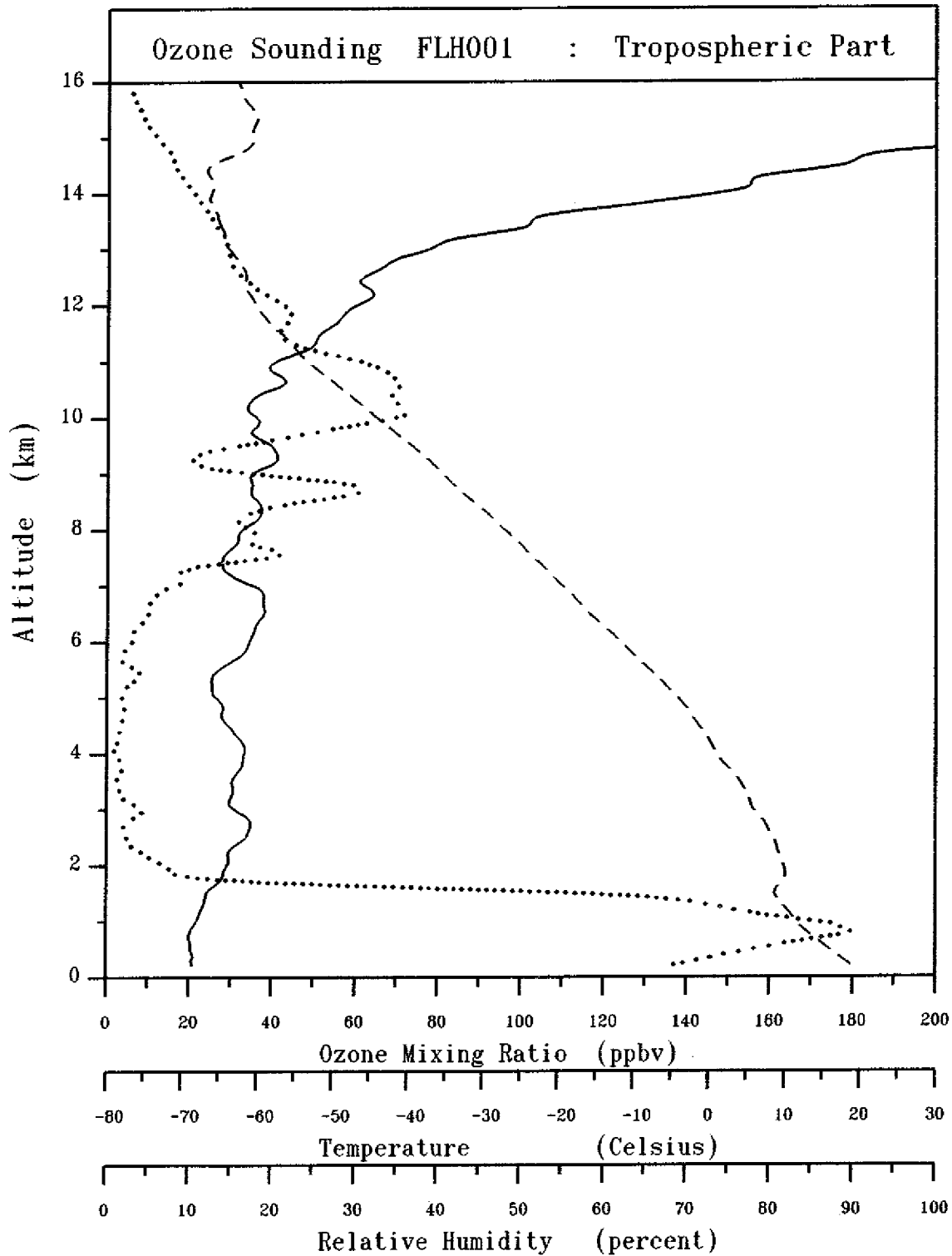
Ozone Soundings during ANT-V/5 (March/April 1987)					
Flight- Number	Date dd-mm-year	Time hh:mm (UTC)	Latitude deg:min	Longitude deg:min	Page
1	23- 3-1987	18: 0	-36: 0'	-45: 0'	10
2	24- 3-1987	17:45	-34: 15'	-40: 18'	12
3	25- 3-1987	17:25	-32: 30'	-35: 42'	14
4	26- 3-1987	17:45	-30: 30'	-31: 18'	16
5	27- 3-1987	17:30	-27: 12'	-30: 0'	18
6	28- 3-1987	17:23	-22: 48'	-30: 0'	20
7	29- 3-1987	14:50	-18: 30'	-30: 0'	22
8	30- 3-1987	14: 0	-13: 54'	-30: 0'	24
9	31- 3-1987	15:15	-9: 30'	-30: 0'	26
10	1- 4-1987	16:10	-5: 6'	-30: 0'	28
11	2- 4-1987	16: 0	0: 6'	-30: 0'	30
12	3- 4-1987	14:30	4: 18'	-30: 0'	32
13	3- 4-1987	23:10	5: 6'	-30: 0'	34
14	5- 4-1987	17:35	13: 30'	-30: 0'	36
16	6- 4-1987	15:35	18: 18'	-30: 0'	38
17	7- 4-1987	1: 0	19: 24'	-30: 0'	40
18	7- 4-1987	15:28	22: 48'	-30: 0'	42
(1) 19	8- 4-1987	15:35	27: 18'	-30: 0'	44
(1) 20	8- 4-1987	15:35	27: 18'	-30: 0'	46
21	9- 4-1987	14:15	29: 54'	-28: 30'	48
(2) 22	10- 4-1987	15:10	33: 30'	-27: 12'	50
(2) 23	10- 4-1987	15:10	33: 30'	-27: 12'	52
24	12- 4-1987	20:30	40: 54'	-21: 12'	54
26	13- 4-1987	13:25	43: 30'	-18: 12'	56
27	13- 4-1987	17:35	44: 18'	-17: 12'	58
28	13- 4-1987	20:47	44: 36'	-16: 48'	60
(3) 29	14- 4-1987	14:20	47: 0'	-13: 42'	62
(3) 30	14- 4-1987	14:20	47: 0'	-13: 42'	64

(1),(2),(3) : Twin sounding

Ozone Soundings during ANT-VII/1 (September/October 1988)					
Flight- Number	Date dd-mm-year	Time hh:mm (UTC)	Latitude deg:min	Longitude deg:min	Page
50	16- 9-1988	19:40	52: 24'	3: 24'	66
51	17- 9-1988	14:55	50: 6'	-2: 12'	68
52	18- 9-1988	10: 5	47: 27'	-7: 36'	70
53	18- 9-1988	22: 0	45: 48'	-10: 30'	72
54	19- 9-1988	10: 0	44: 6'	-13: 33'	74
55	19- 9-1988	21:45	42: 24'	-16: 18'	76
56	20- 9-1988	22: 0	40: 54'	-18: 51'	78
57	21- 9-1988	10:25	39: 30'	-21: 24'	80
58	21- 9-1988	21:45	38: 18'	-23: 48'	82
59	22- 9-1988	14:20	37: 7'	-26: 0'	84
60	23- 9-1988	11:45	32: 54'	-28: 24'	86
61	23- 9-1988	16:11	31: 48'	-29: 0'	88
62	23- 9-1988	22:45	30: 45'	-29: 36'	90
63	24- 9-1988	12:15	28: 15'	-30: 0'	92
64	24- 9-1988	21:15	26: 3'	-30: 0'	94
65	25- 9-1988	12:10	22: 37'	-30: 0'	96
66	26- 9-1988	2: 0	19: 27'	-30: 0'	98
67	26- 9-1988	11:30	17: 13'	-30: 0'	100
68	26- 9-1988	21:30	15: 0'	-30: 0'	102
69	27- 9-1988	11:50	11: 51'	-30: 0'	104
70	27- 9-1988	18:35	10: 18'	-30: 0'	106
71	28- 9-1988	1:15	8: 48'	-30: 0'	108
72	28- 9-1988	10:40	6: 33'	-30: 0'	110
73	28- 9-1988	16:30	5: 12'	-30: 0'	112
74	28- 9-1988	22:30	4: 1'	-30: 0'	114
75	29- 9-1988	11:50	1: 12'	-30: 0'	116
76	29- 9-1988	22:40	-1: 1'	-30: 0'	118
77	30- 9-1988	11:45	-3: 51'	-30: 0'	120
78	30- 9-1988	23: 0	-6: 18'	-30: 0'	122
79	1-10-1988	11:45	-9: 6'	-30: 0'	124
80	1-10-1988	19:15	-10: 45'	-30: 0'	126
81	2-10-1988	15: 0	-15: 3'	-30: 0'	128
82	2-10-1988	22:30	-16: 42'	-30: 0'	130
83	3-10-1988	12: 0	-19: 46'	-30: 0'	132
84	3-10-1988	22:30	-22: 6'	-30: 0'	134
85	4-10-1988	12:25	-25: 18'	-30: 0'	136
86	4-10-1988	22:15	-27: 33'	-30: 0'	138
87	5-10-1988	11:45	-30: 4'	-30: 36'	140
88	5-10-1988	23: 0	-30: 24'	-33: 36'	142
89	6-10-1988	12:30	-30: 48'	-36: 30'	144

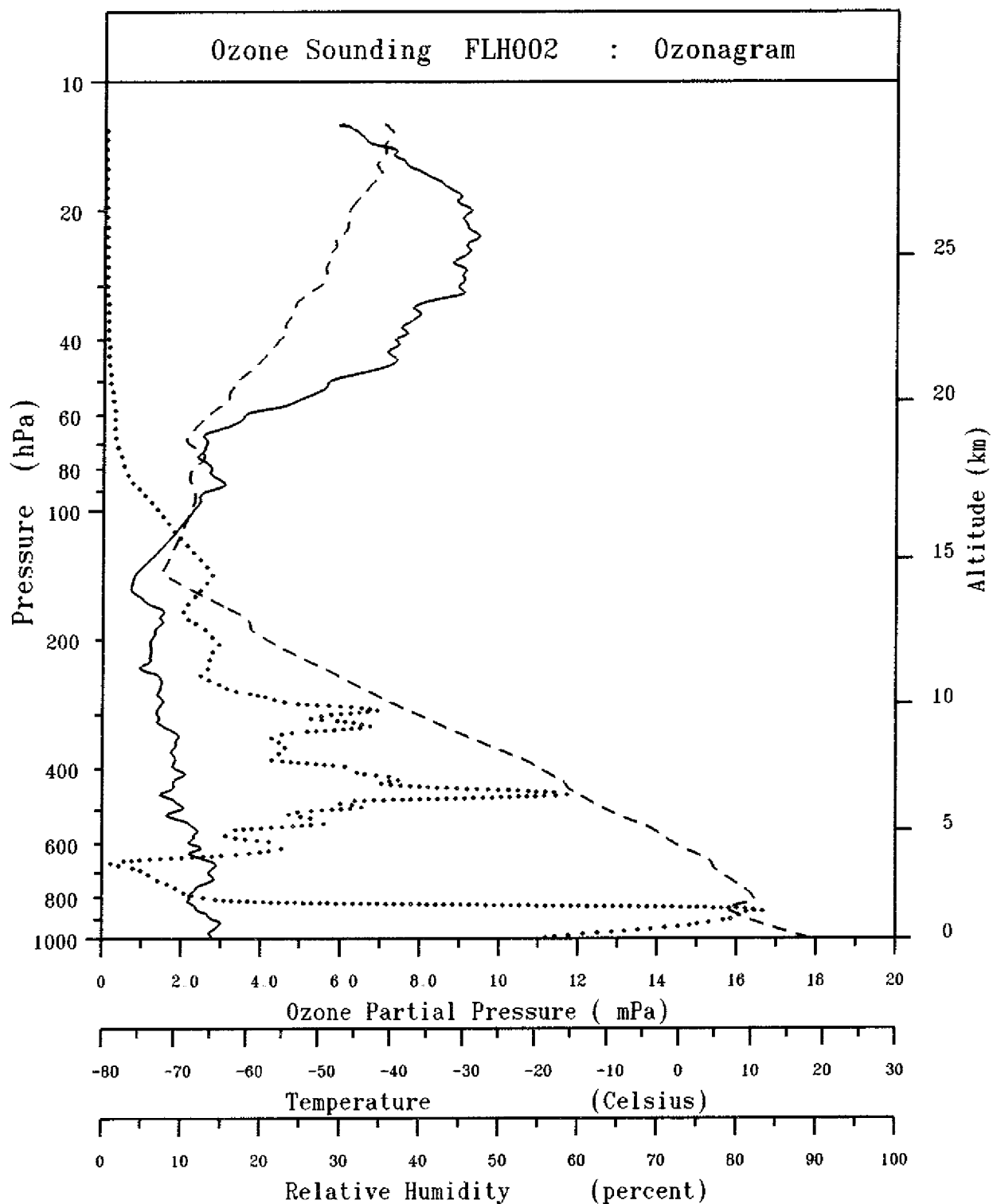


Date	23-03-1987	—	Ozone
Time at launch	18:00 (UTC)	- - - -	Temperature
Location	36:00 S , 45:00 W	.....	Relative Humidity

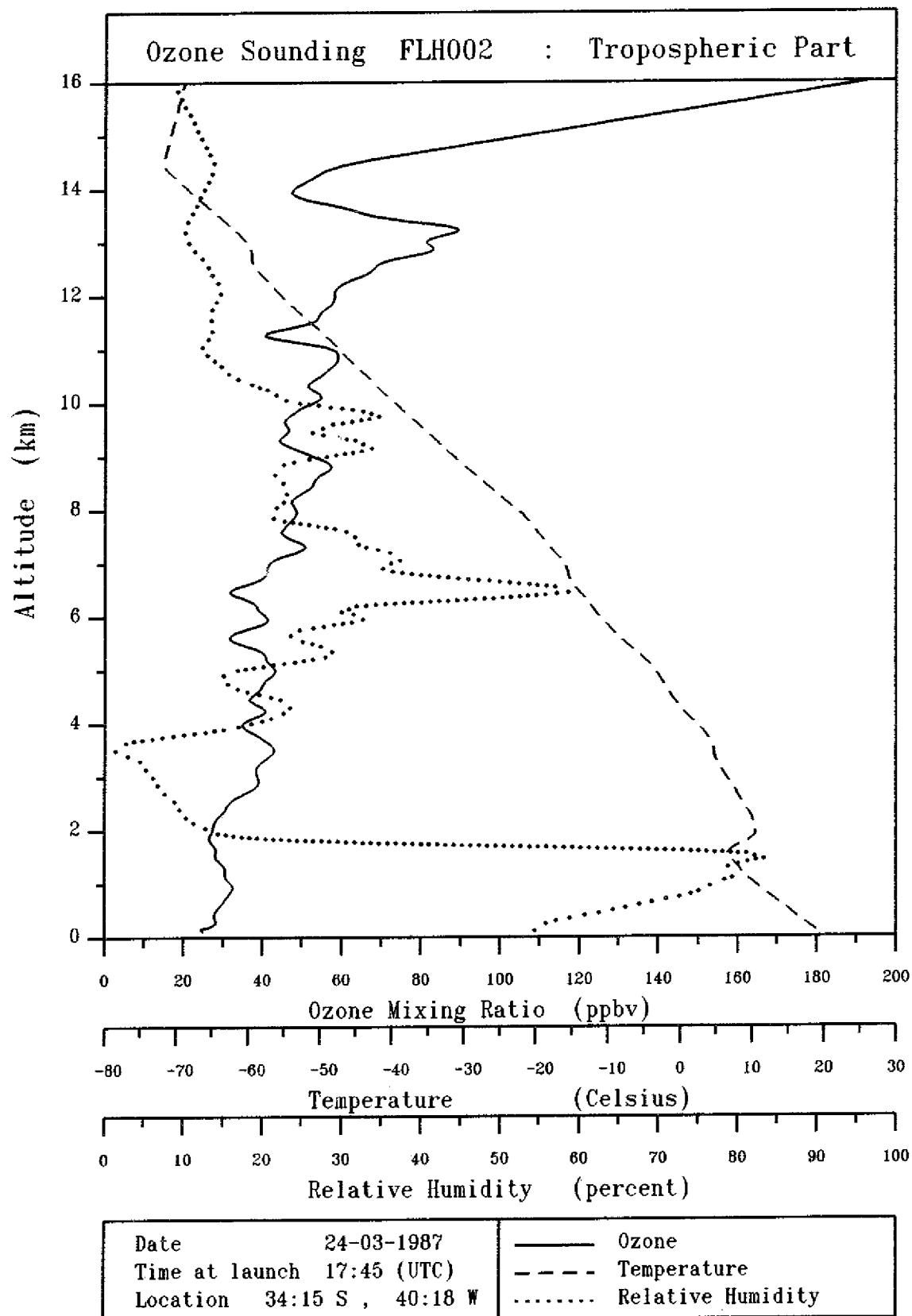


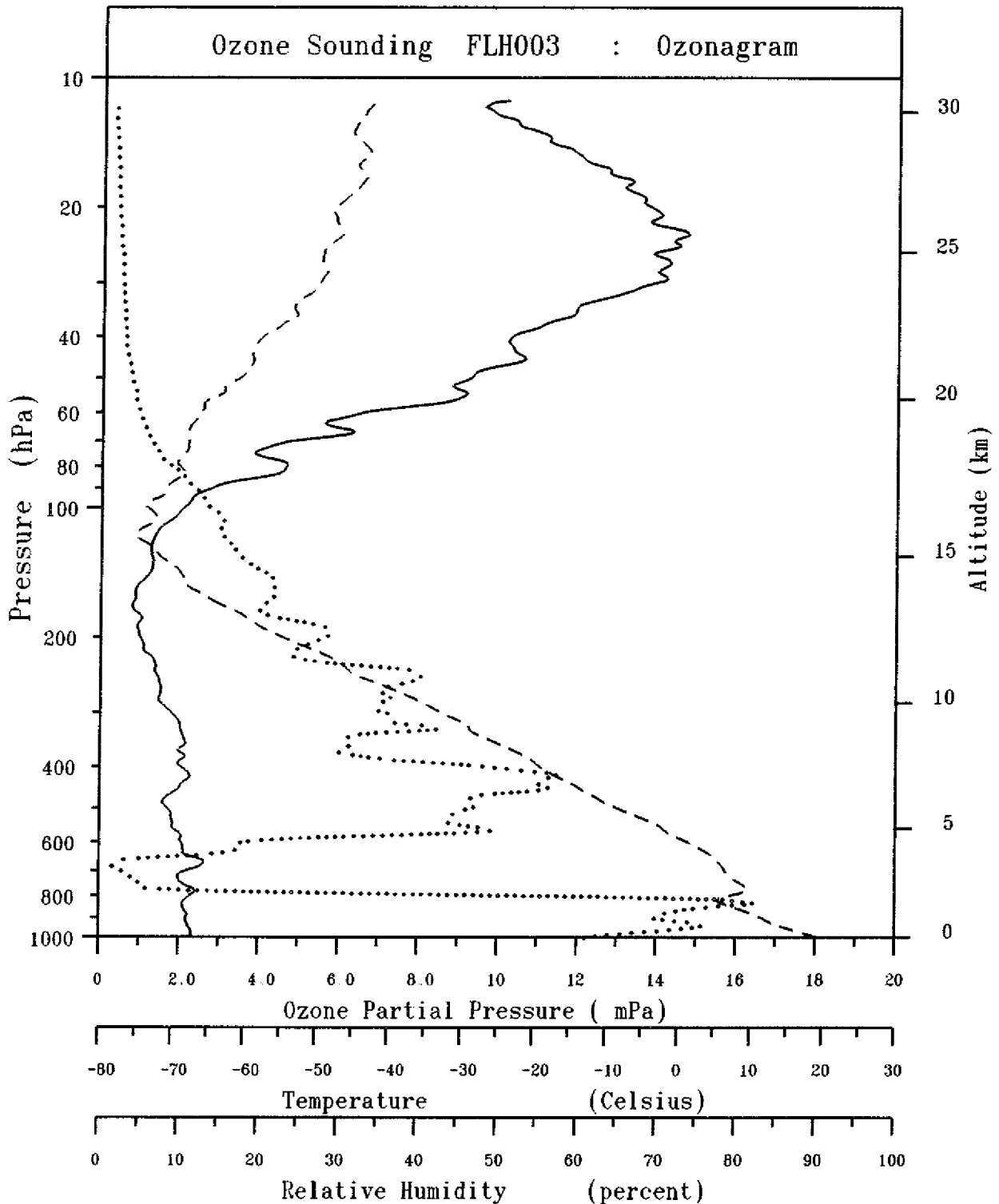
Date 23-03-1987
 Time at launch 18:00 (UTC)
 Location 36:00 S , 45:00 W

— Ozone
 --- Temperature
 Relative Humidity



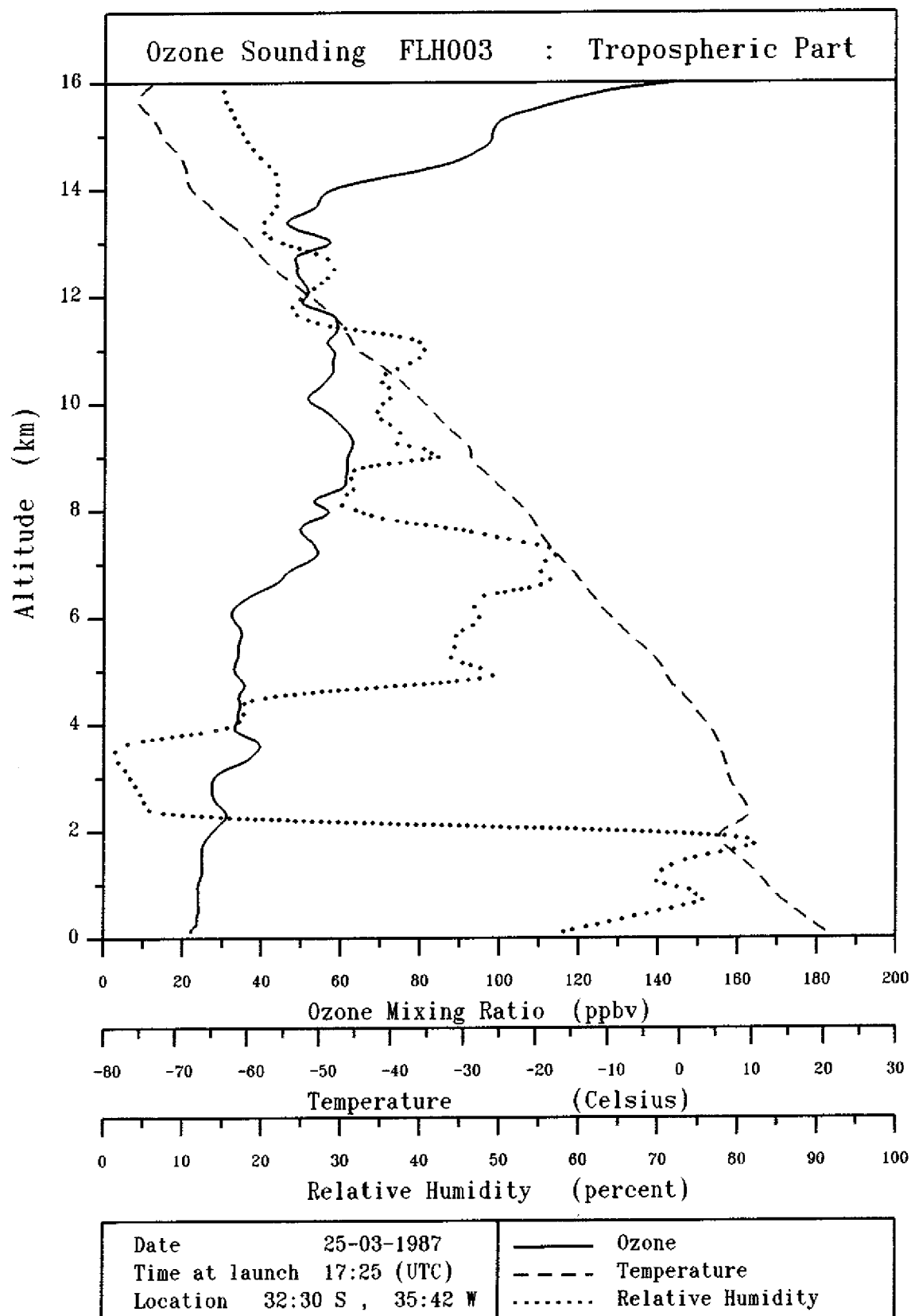
Date	24-03-1987	—	Ozone
Time at launch	17:45 (UTC)	- - -	Temperature
Location	34:15 S , 40:18 W	.....	Relative Humidity

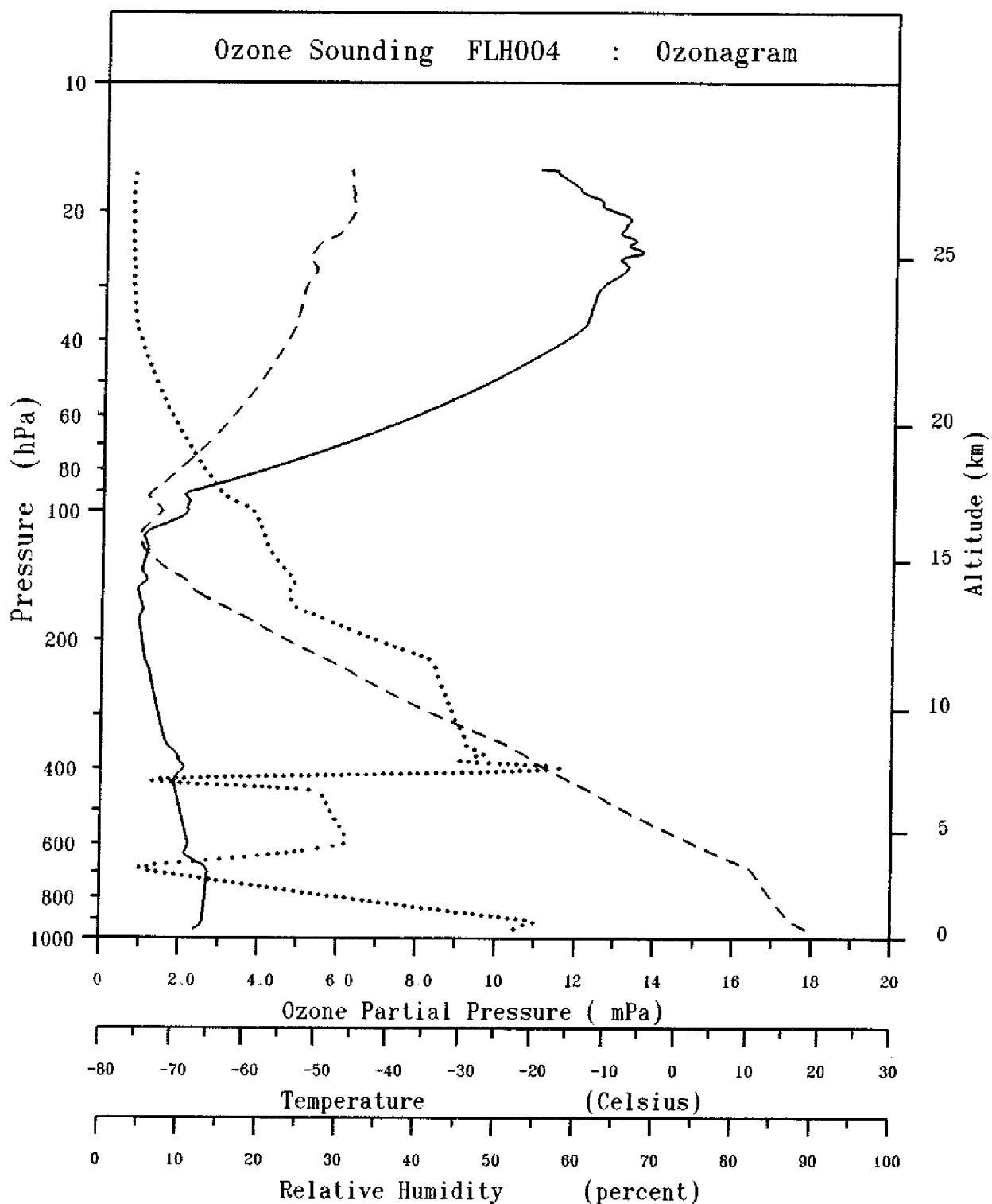




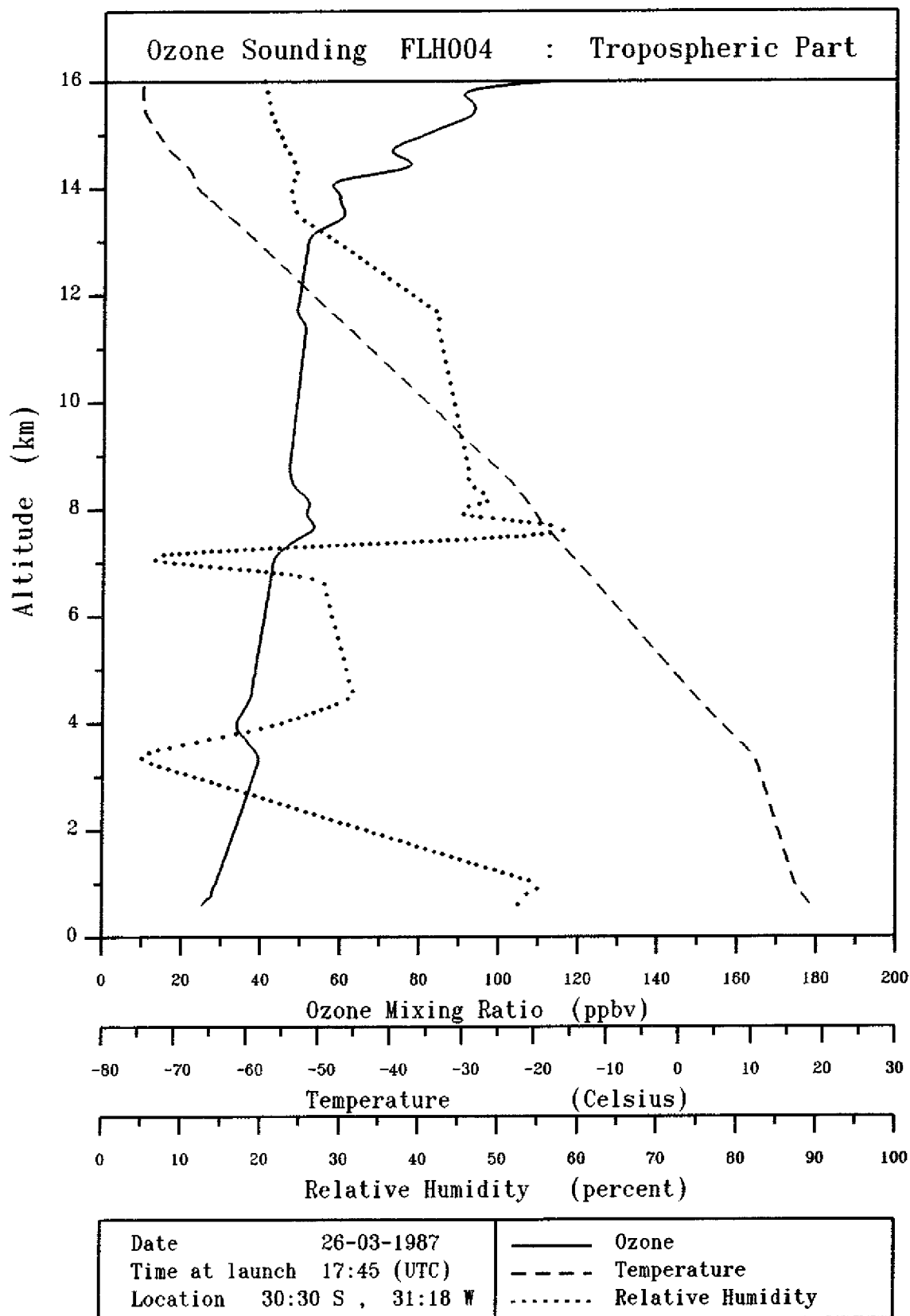
Date 25-03-1987
 Time at launch 17:25 (UTC)
 Location 32:30 S , 35:42 W

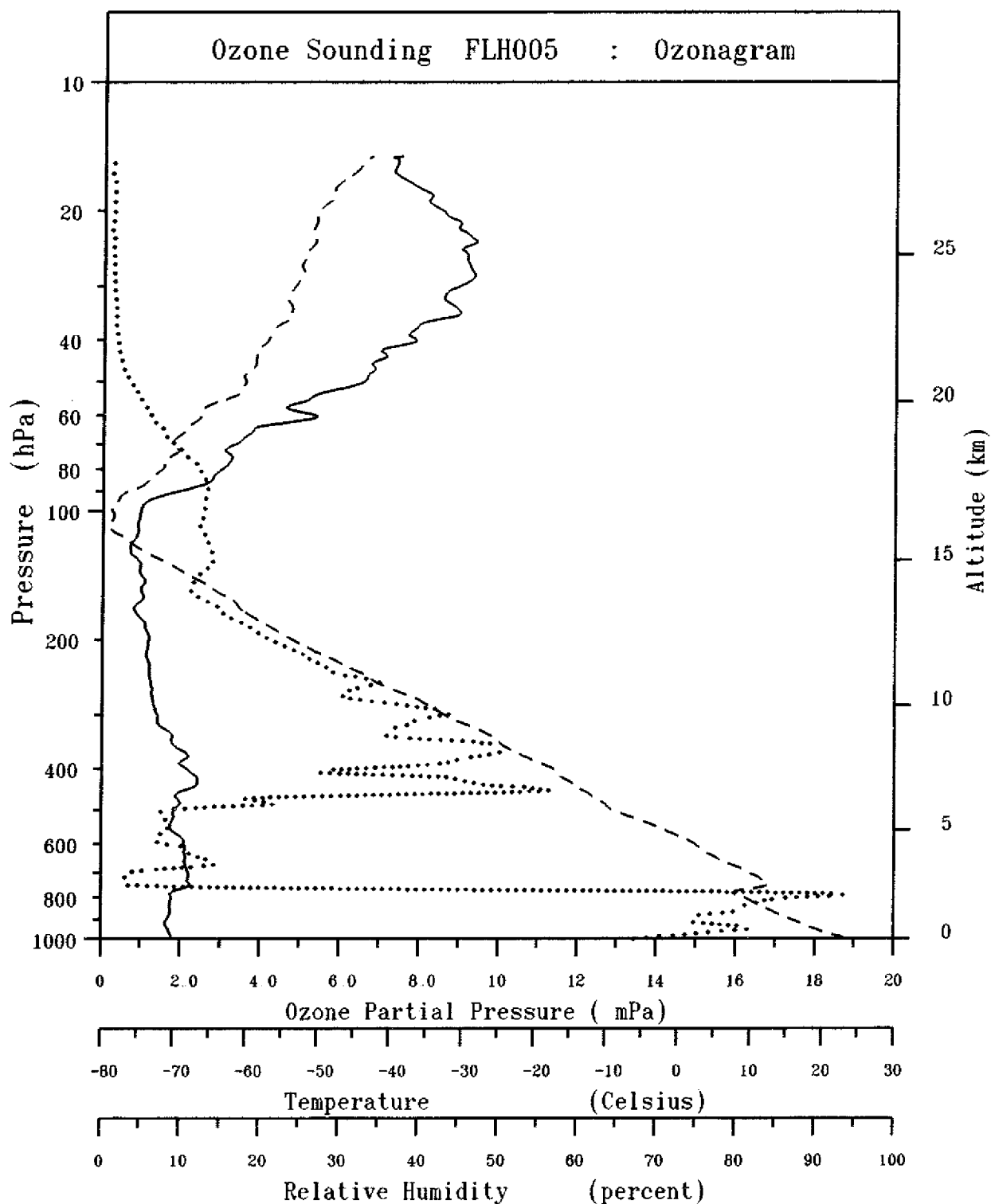
— Ozone
 --- Temperature
 Relative Humidity





Date	26-03-1987	—	Ozone
Time at launch	17:45 (UTC)	- - -	Temperature
Location	30:30 S , 31:18 W	.....	Relative Humidity





Date 27-03-1987

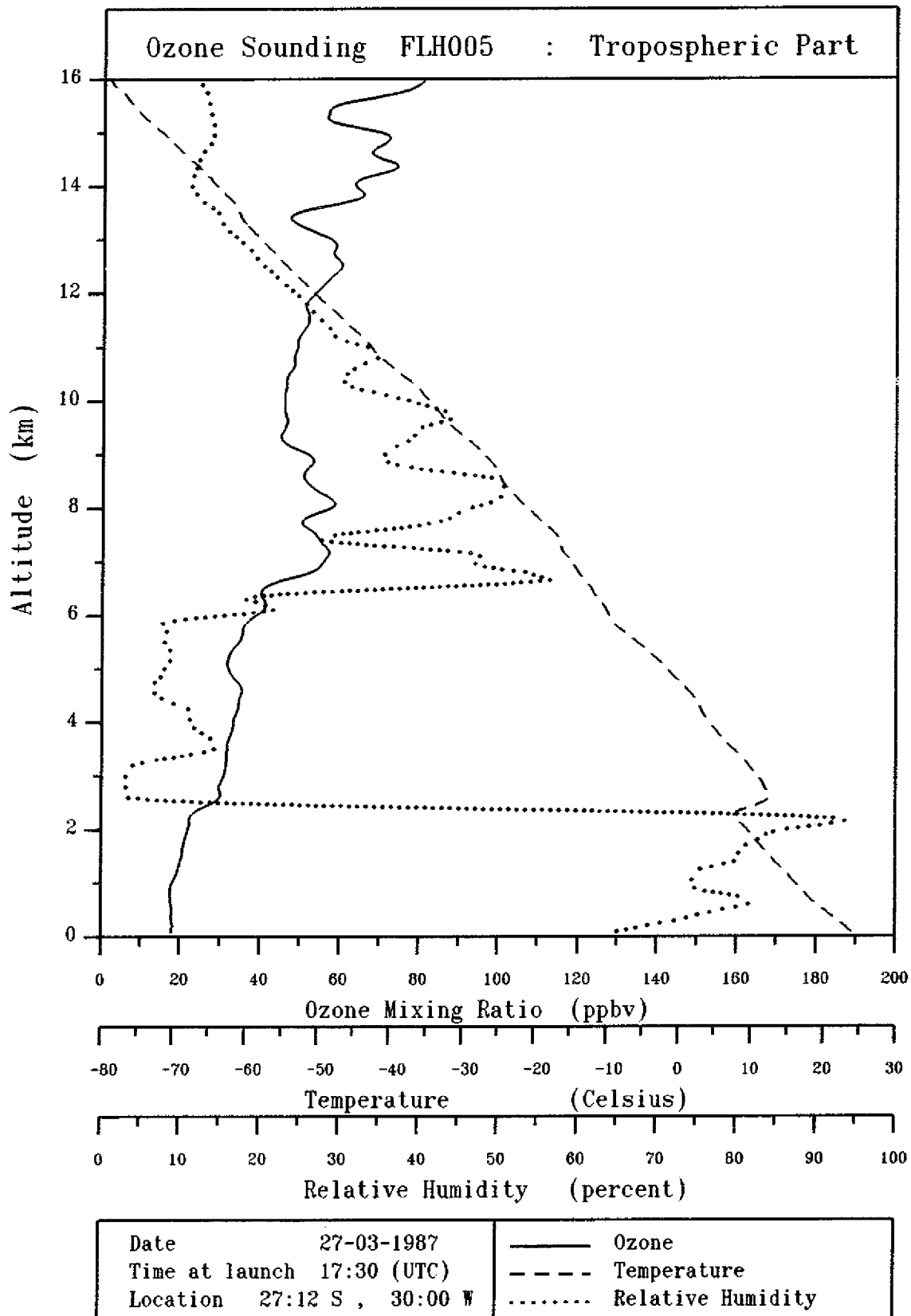
Time at launch 17:30 (UTC)

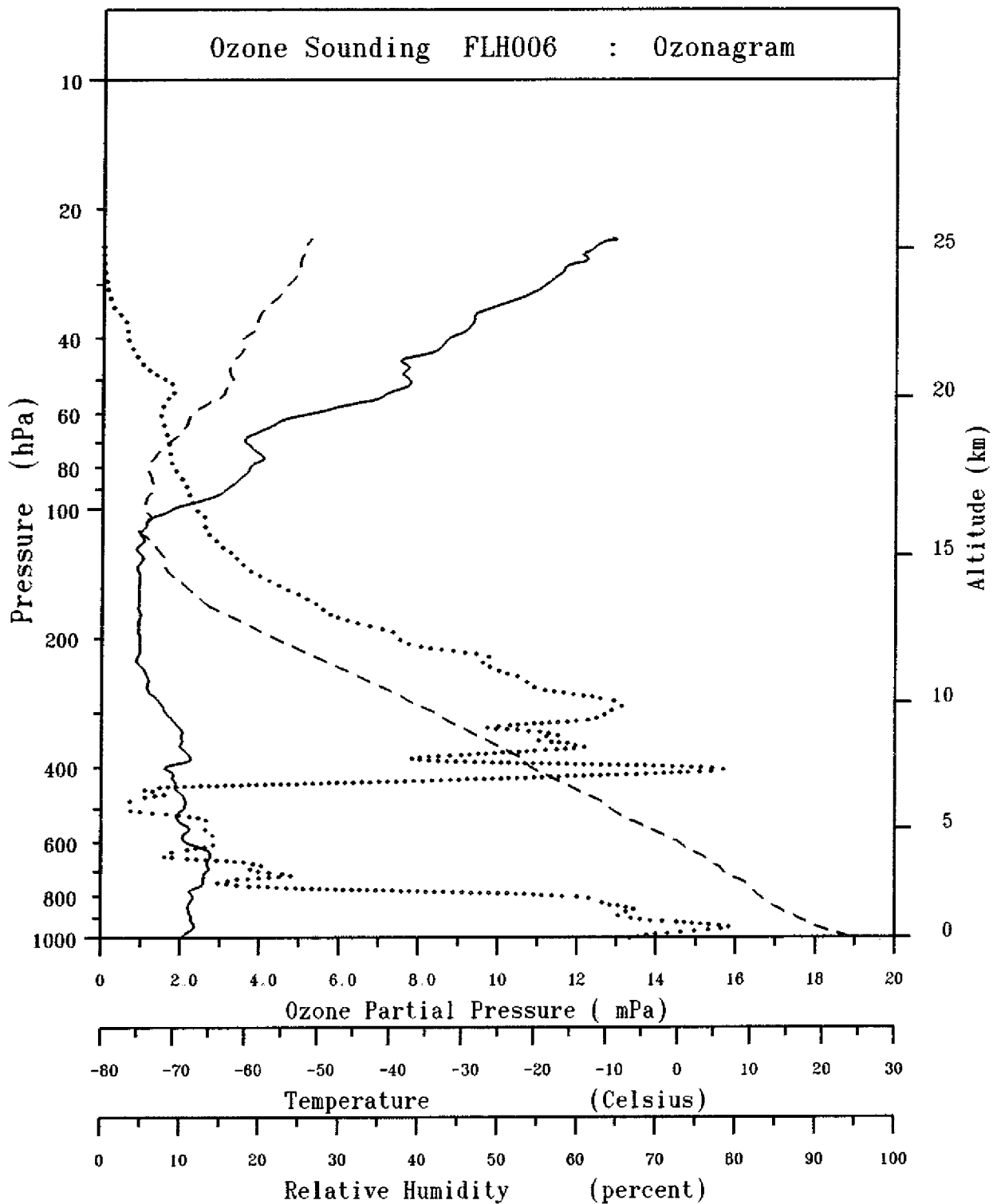
Location 27:12 S , 30:00 W

— Ozone

- - - Temperature

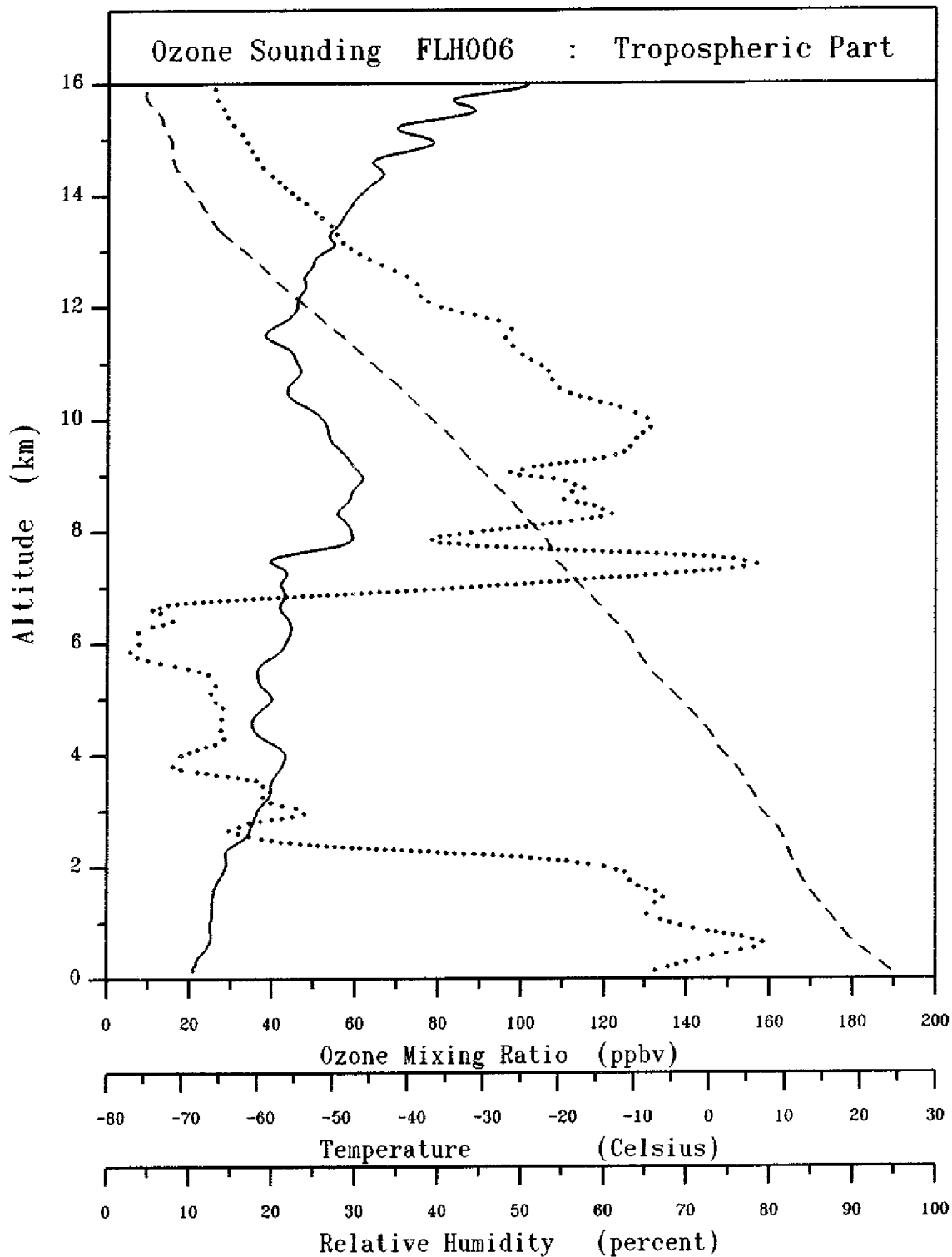
..... Relative Humidity





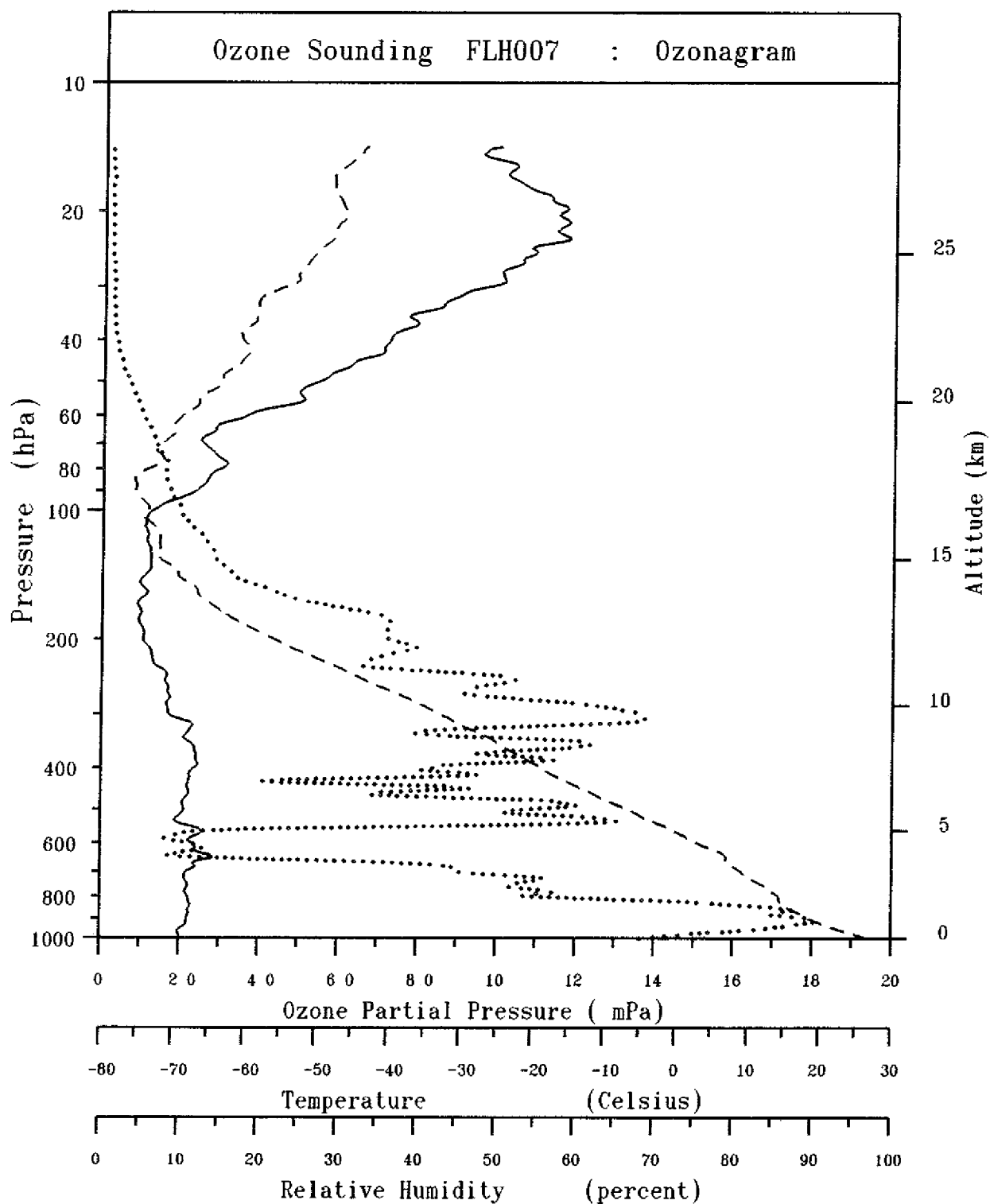
Date 28-03-1987
 Time at launch 17:23 (UTC)
 Location 22:48 S , 30:00 W

— Ozone
 - - - Temperature
 Relative Humidity

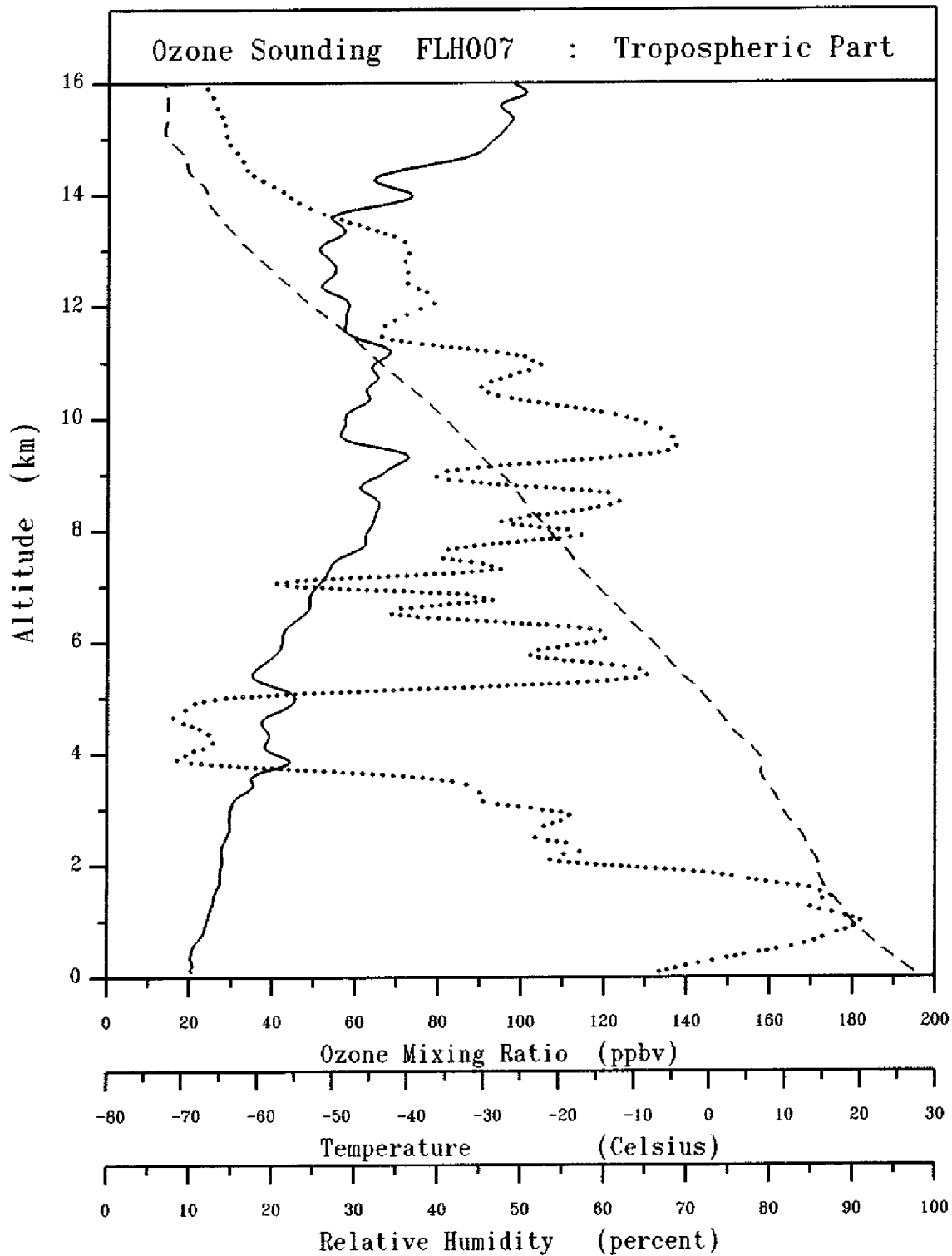


Date 28-03-1987
 Time at launch 17:23 (UTC)
 Location 22:48 S , 30:00 W

— Ozone
 - - - Temperature
 Relative Humidity



Date	29-03-1987	—	Ozone
Time at launch	14:50 (UTC)	- - -	Temperature
Location	18:30 S , 30:00 W	.....	Relative Humidity



Date 29-03-1987

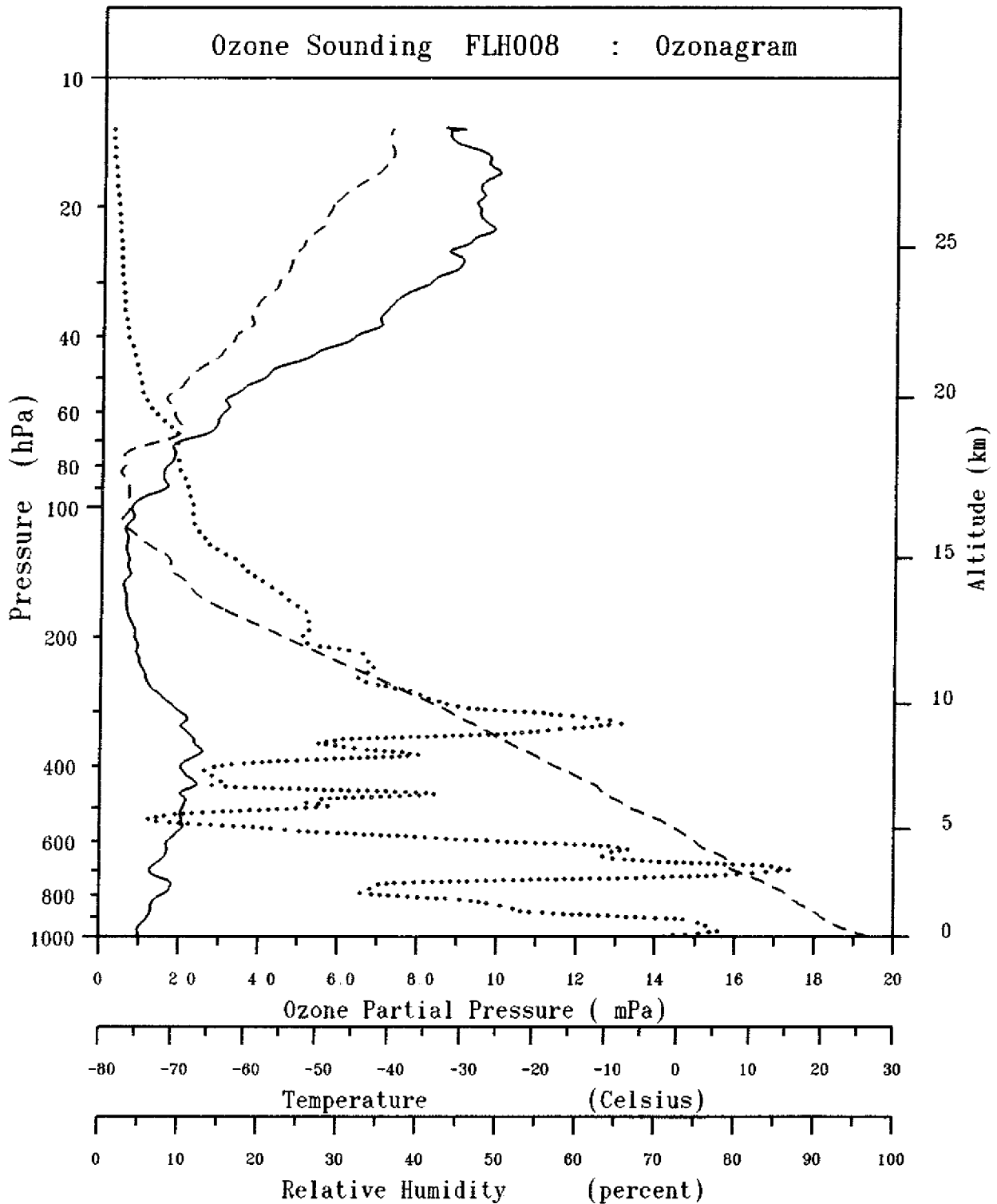
Time at launch 14:50 (UTC)

Location 18:30 S , 30:00 W

— Ozone

- - - Temperature

..... Relative Humidity



Date 30-03-1987

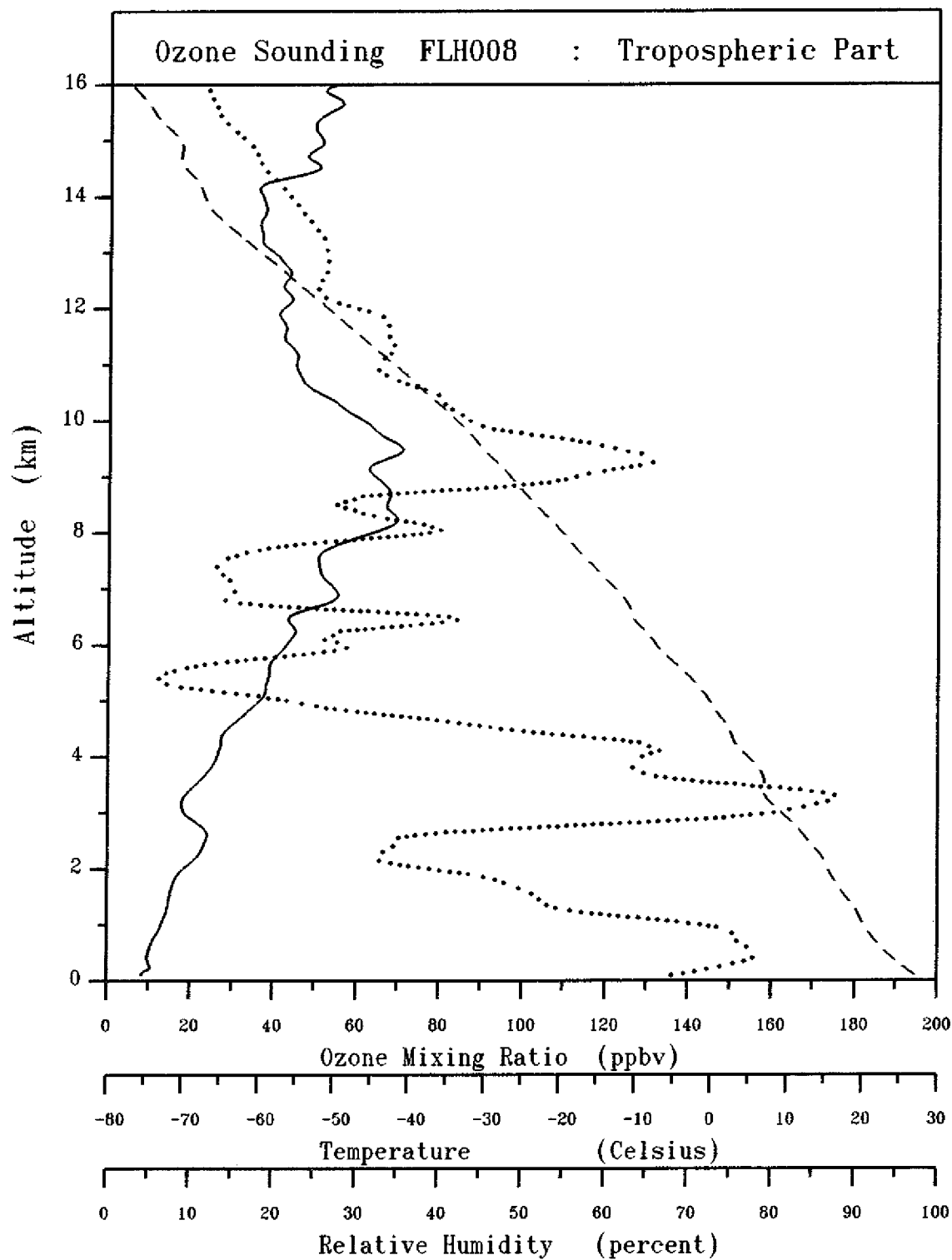
Time at launch 14:00 (UTC)

Location 13:54 S , 30:00 W

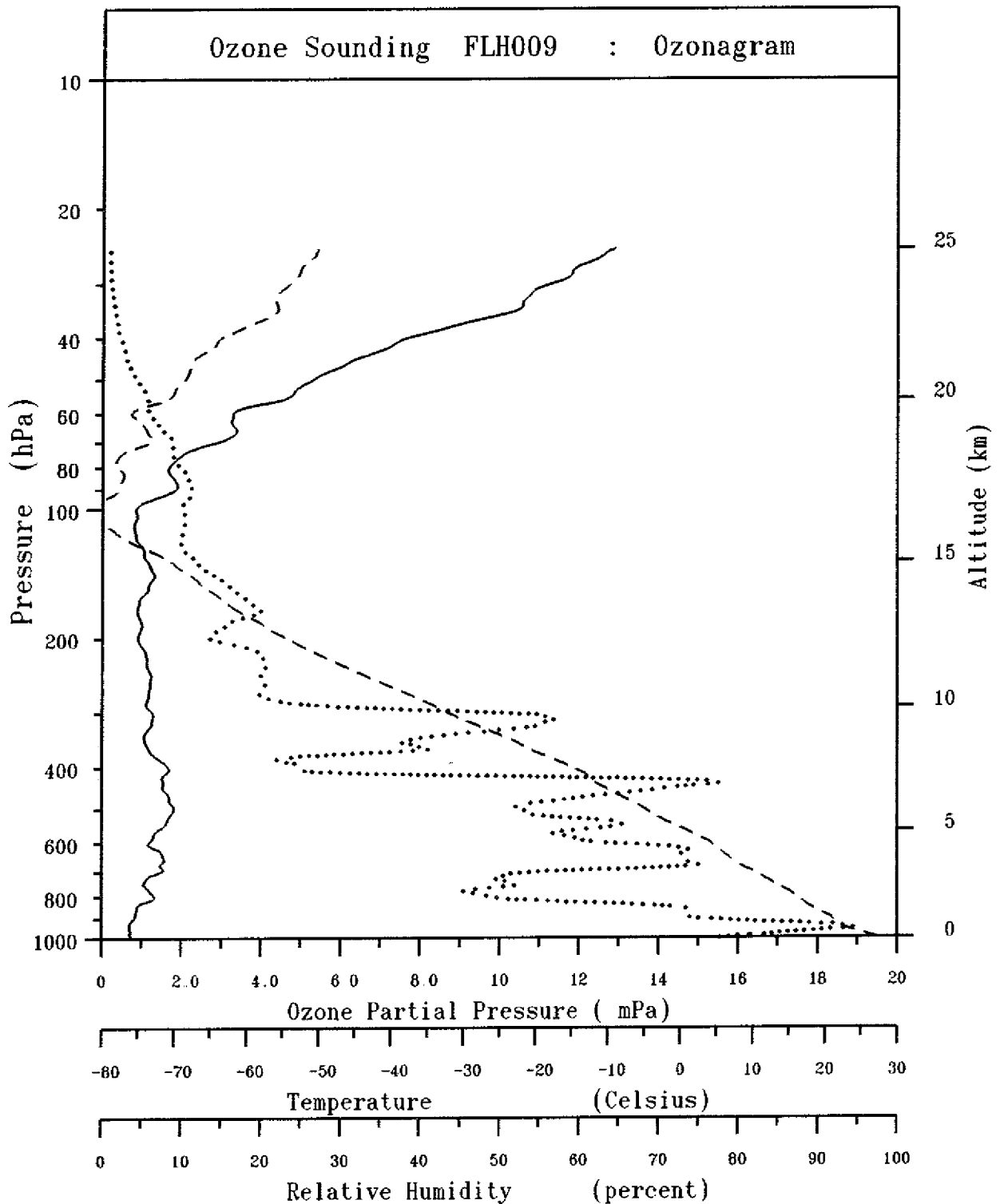
— Ozone

- - - Temperature

..... Relative Humidity

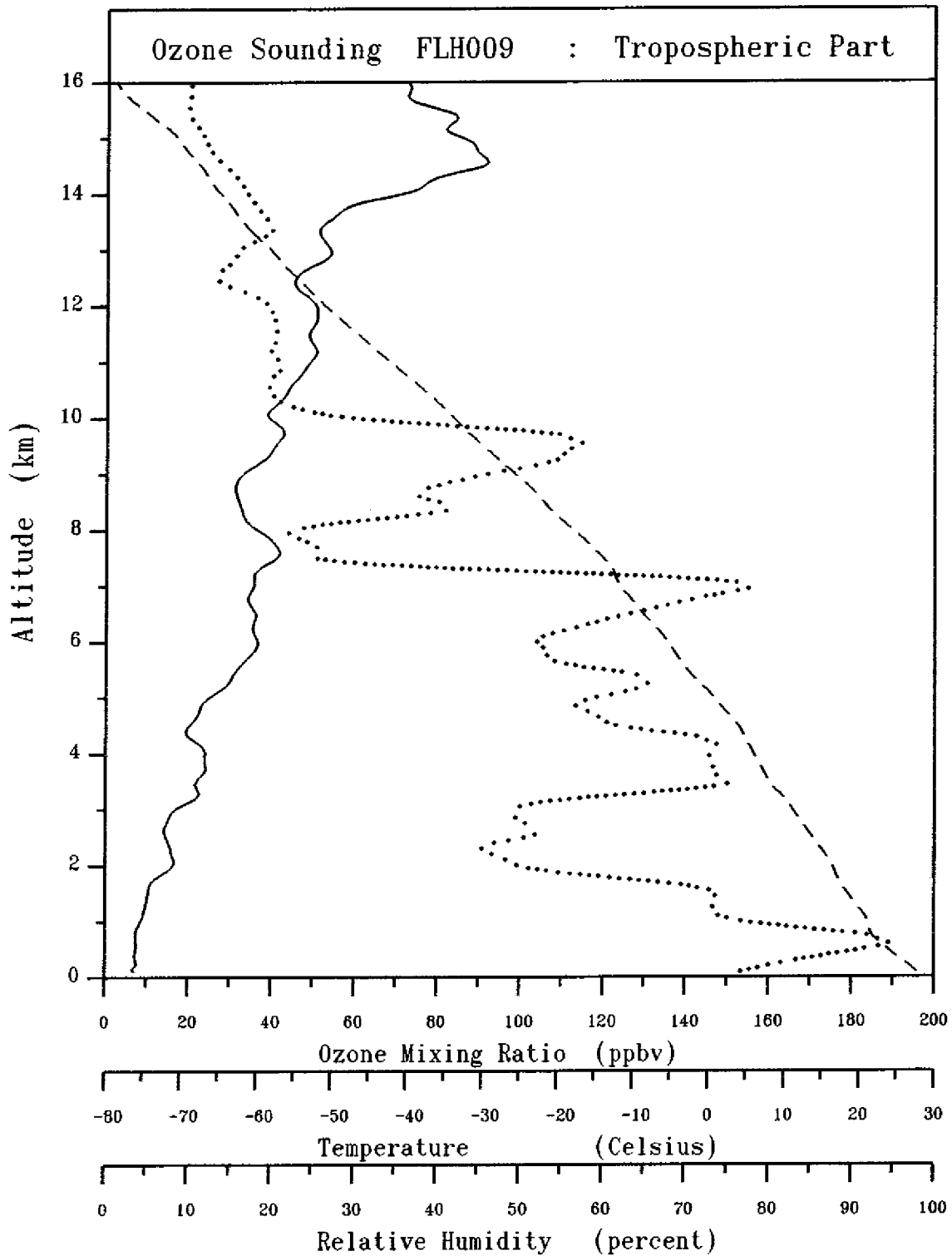


Date	30-03-1987	—	Ozone
Time at launch	14:00 (UTC)	- - - -	Temperature
Location	13:54 S , 30:00 W	.....	Relative Humidity



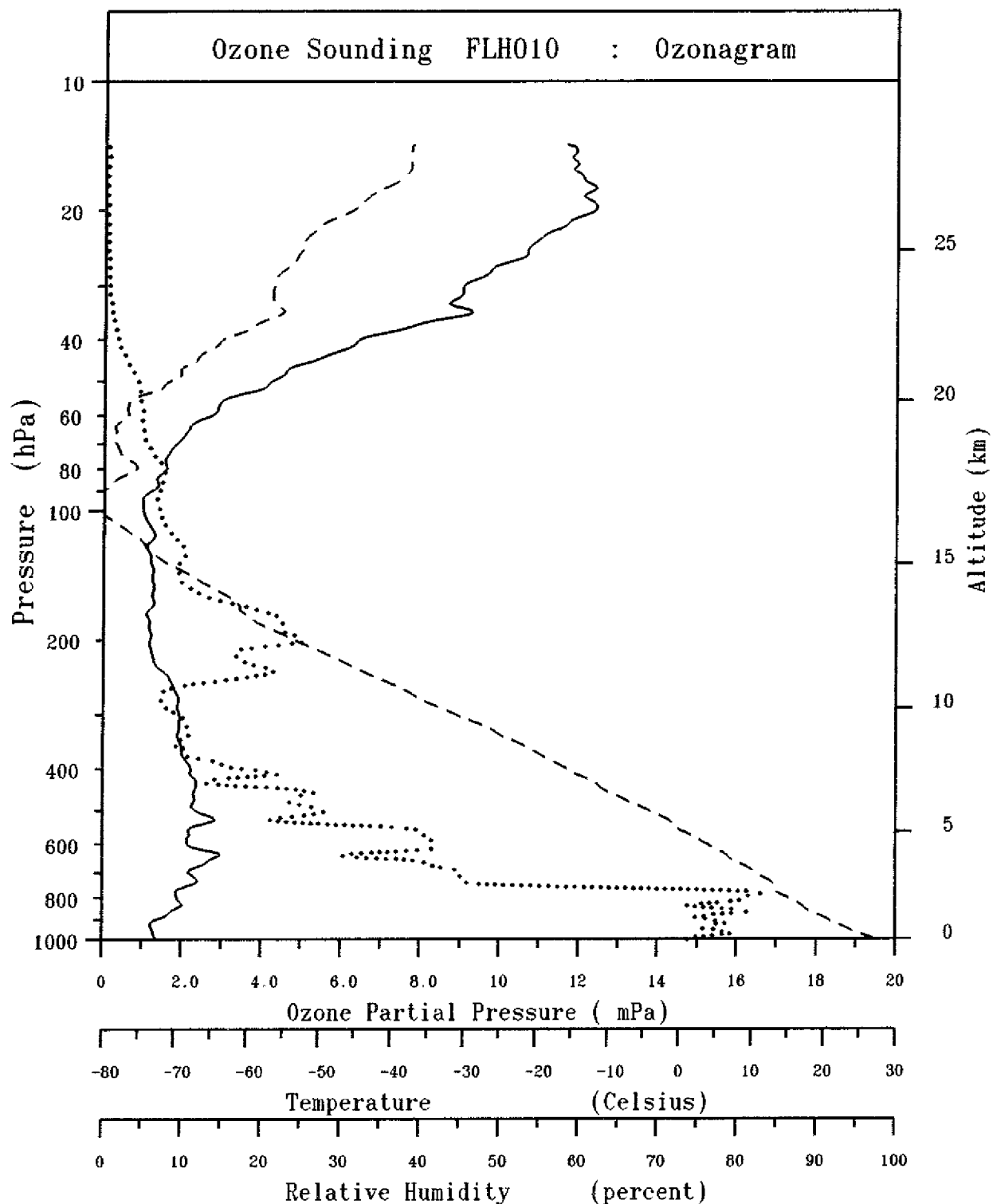
Date 31-03-1987
 Time at launch 15:15 (UTC)
 Location 9:30 S , 30:00 W

— Ozone
 --- Temperature
 Relative Humidity



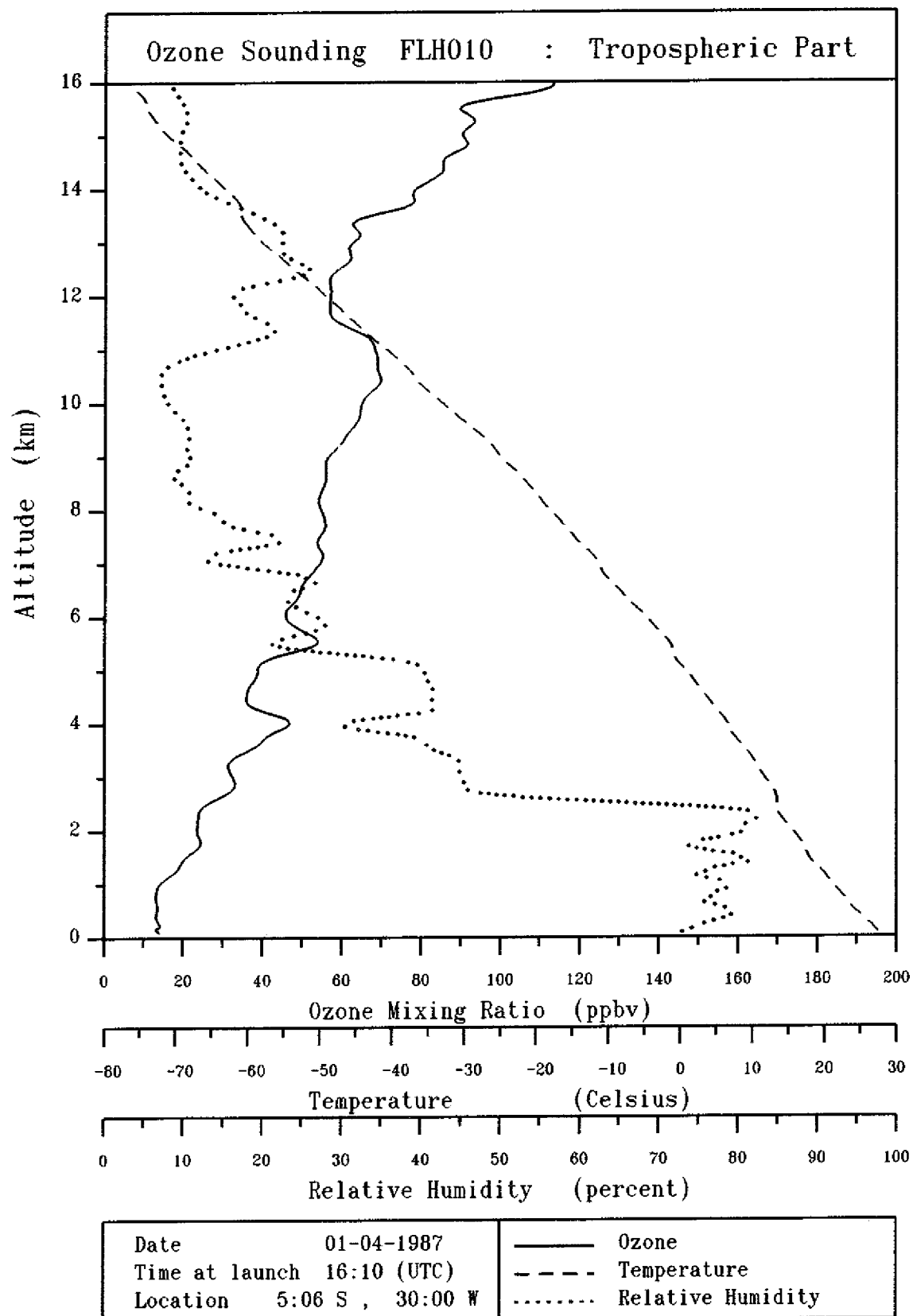
Date 31-03-1987
 Time at launch 15:15 (UTC)
 Location 9:30 S , 30:00 W

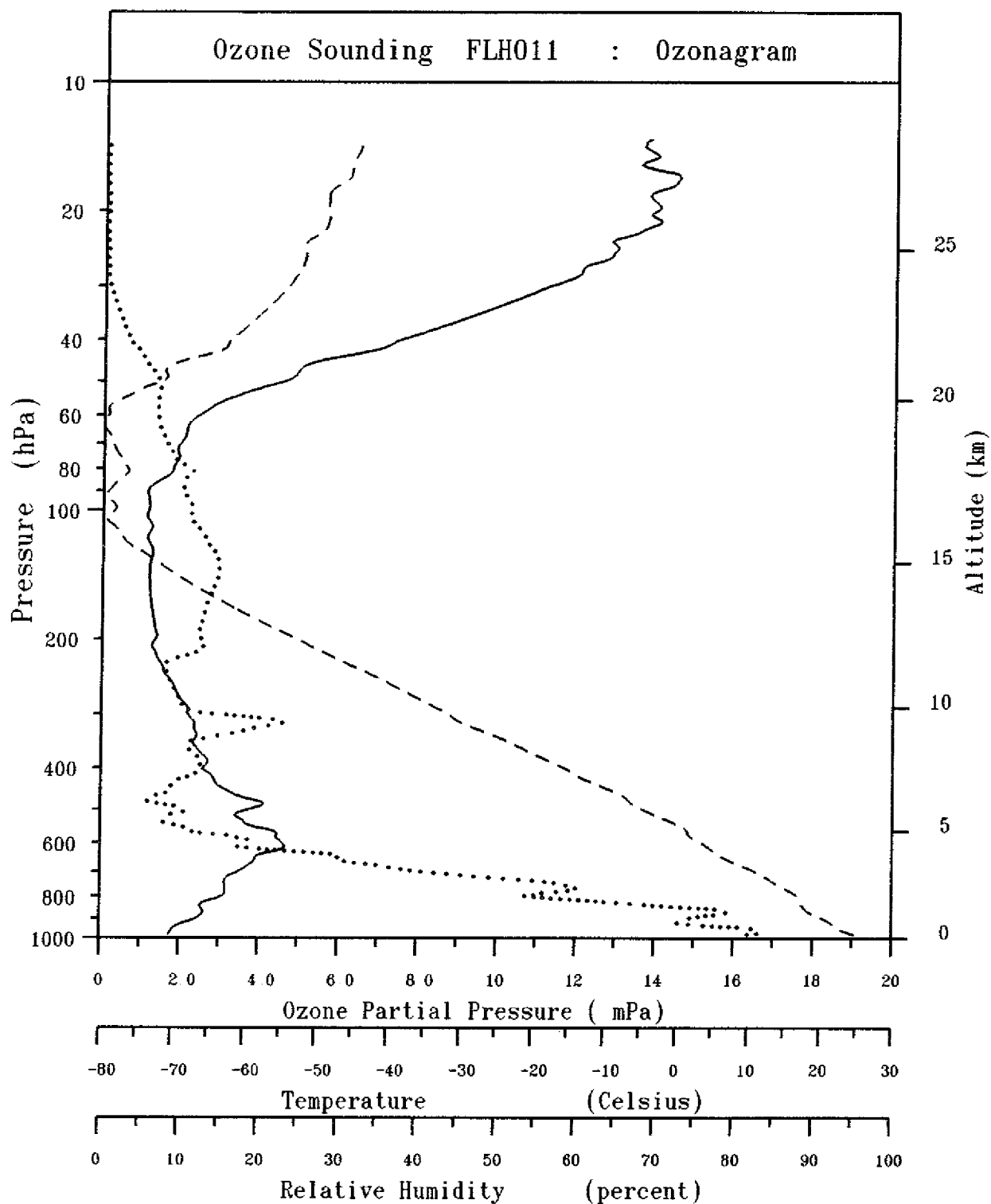
— Ozone
 - - - Temperature
 Relative Humidity



Date 01-04-1987
 Time at launch 16:10 (UTC)
 Location 5:06 S , 30:00 W

— Ozone
 - - - Temperature
 Relative Humidity





Date 02-04-1987

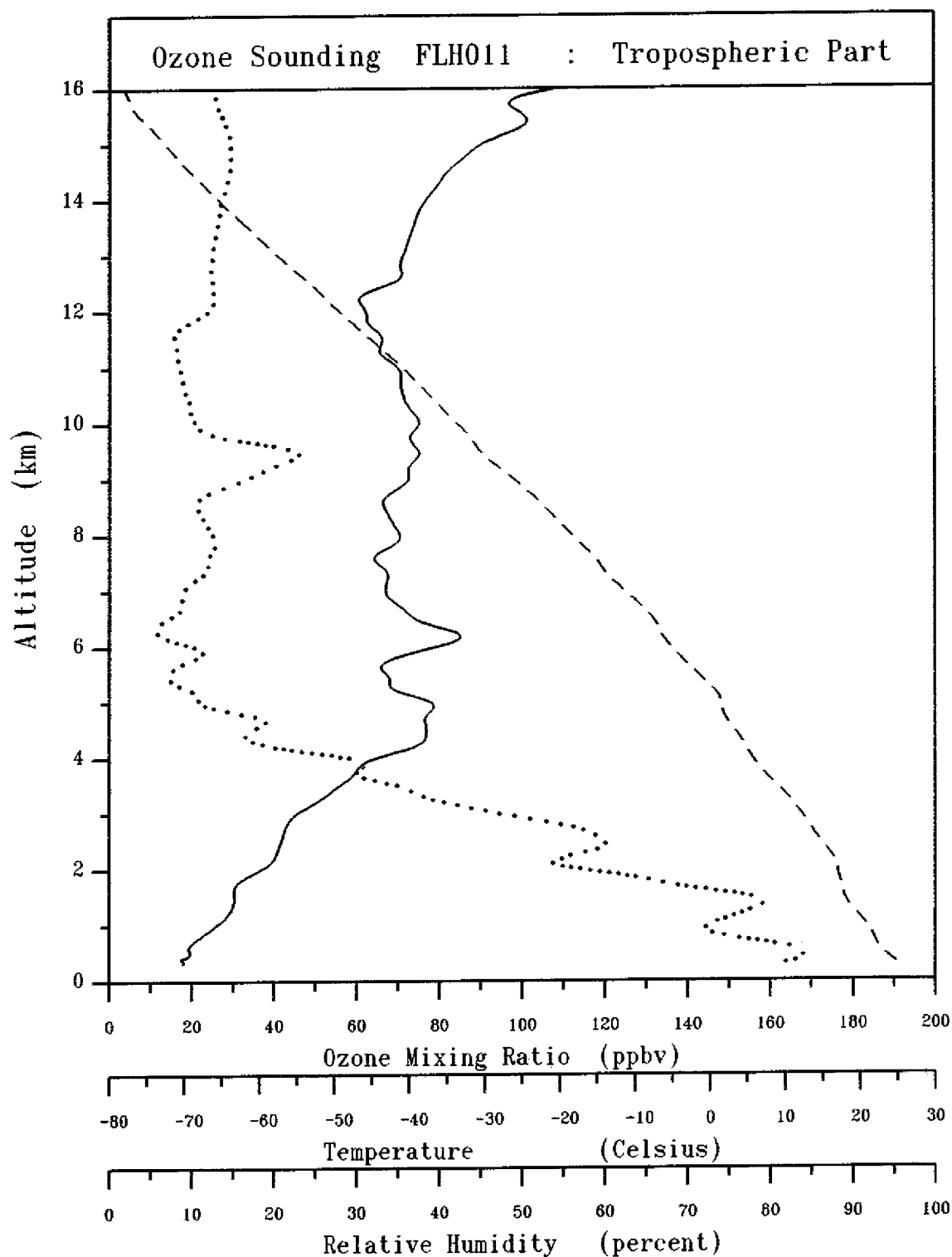
Time at launch 16:00 (UTC)

Location 0:06 S , 30:00 W

— Ozone

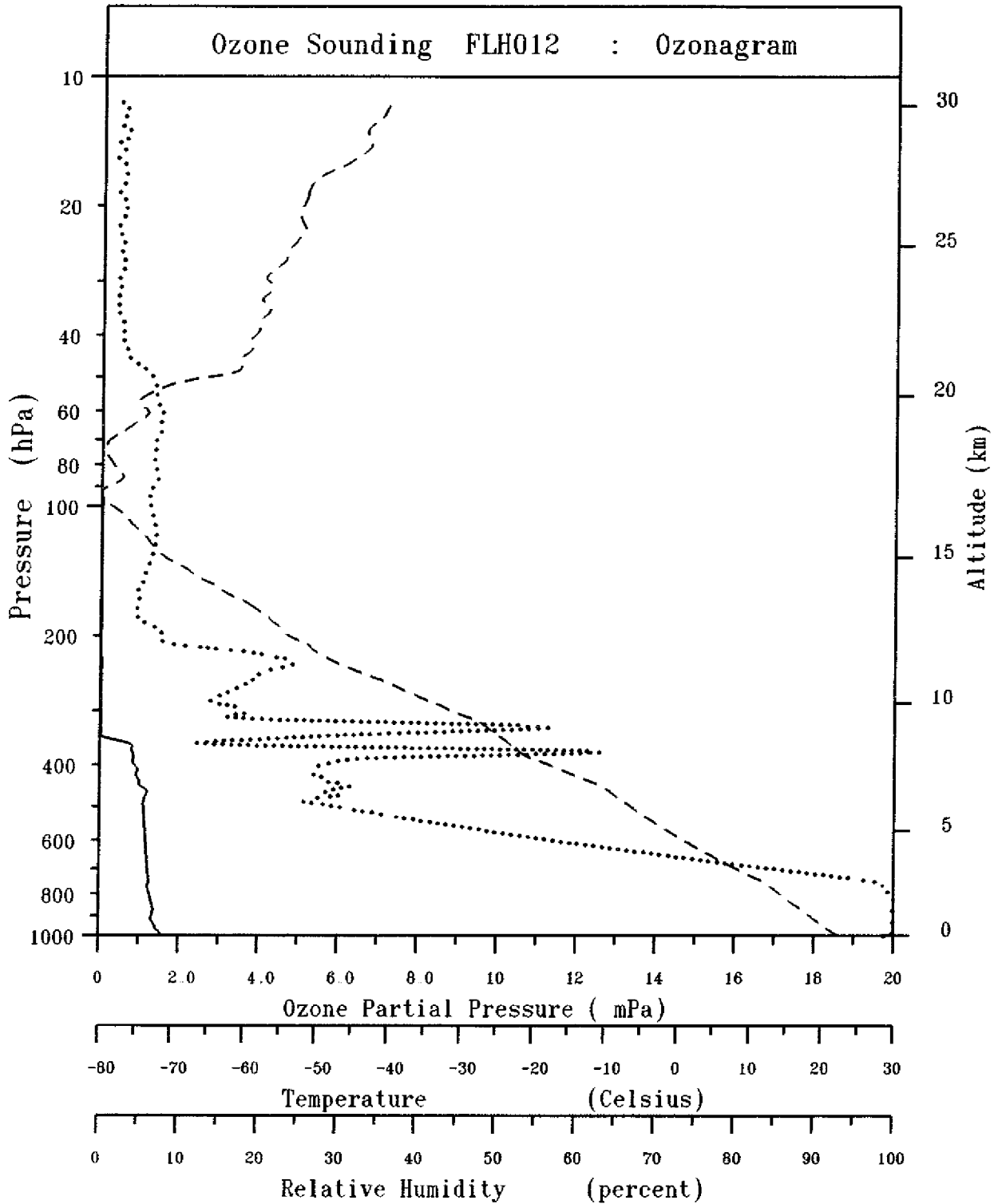
- - - Temperature

..... Relative Humidity



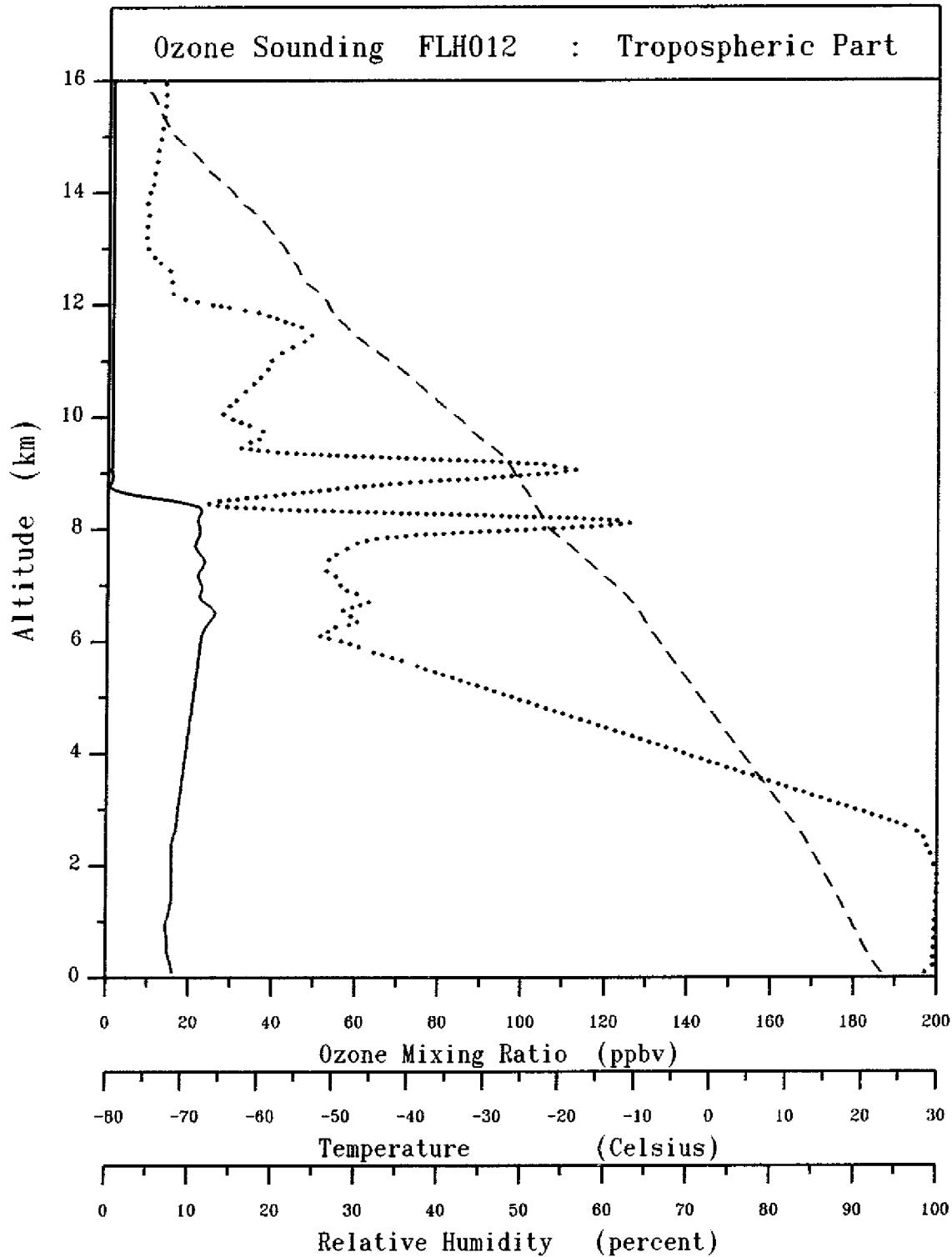
Date 02-04-1987
 Time at launch 16:00 (UTC)
 Location 0:06 S , 30:00 W

— Ozone
 - - - Temperature
 Relative Humidity

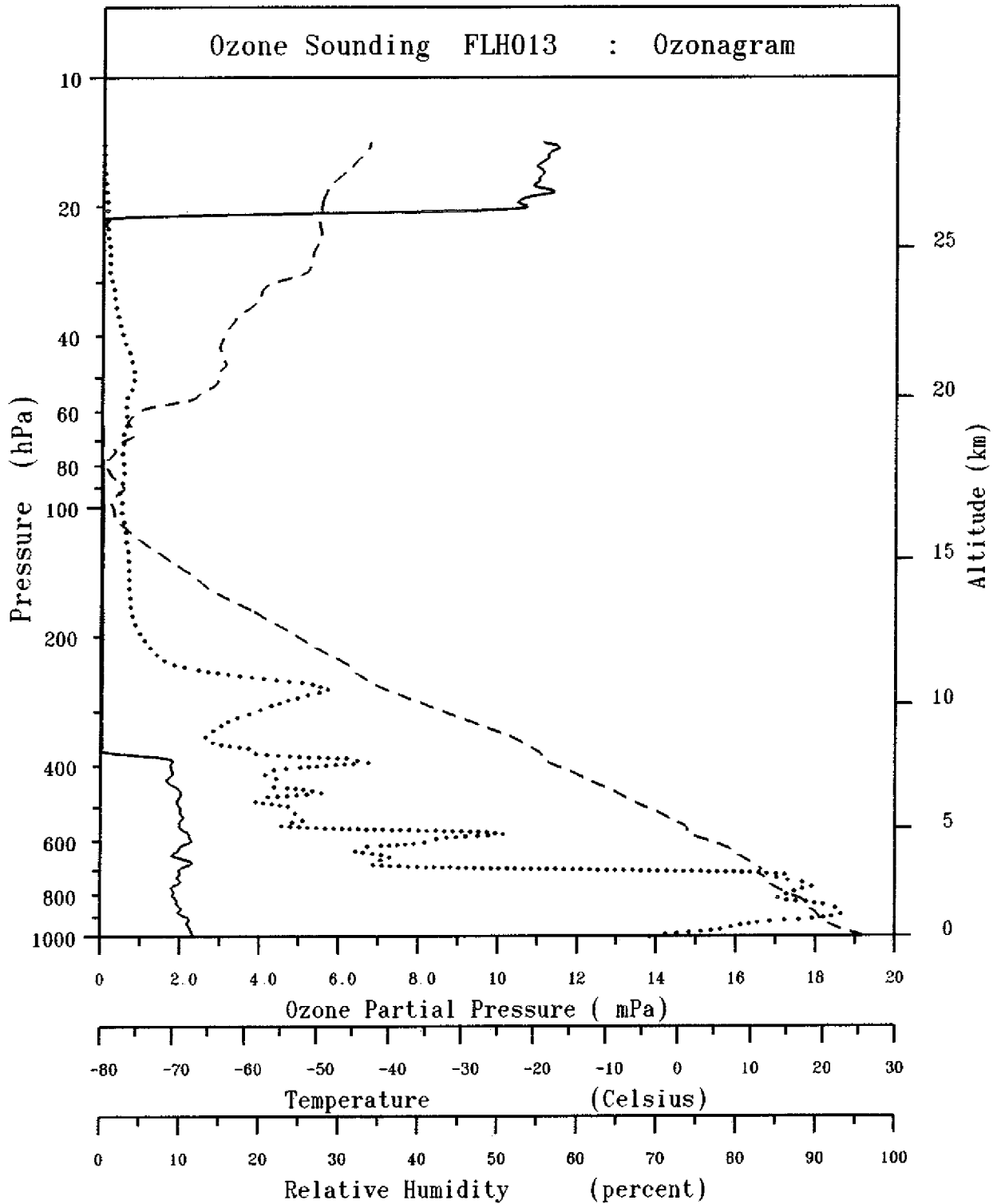


Date 03-04-1987
 Time at launch 14:30 (UTC)
 Location 4:18 N , 30:00 W

— Ozone
 --- Temperature
 Relative Humidity



Date	03-04-1987	—	Ozone
Time at launch	14:30 (UTC)	- - - -	Temperature
Location	4:18 N , 30:00 W	.....	Relative Humidity



Date 03-04-1987

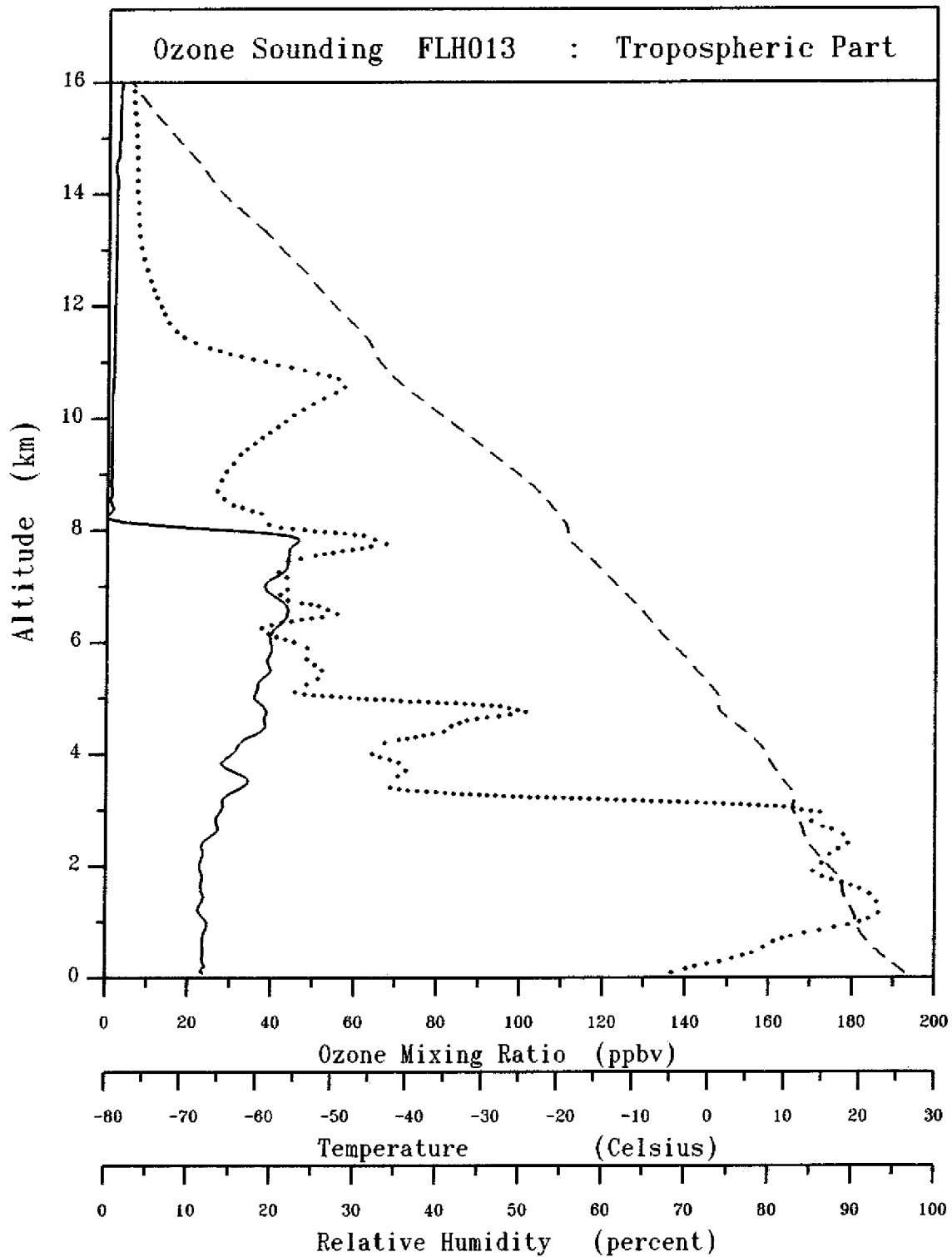
Time at launch 23:10 (UTC)

Location 5:06 N , 30:00 W

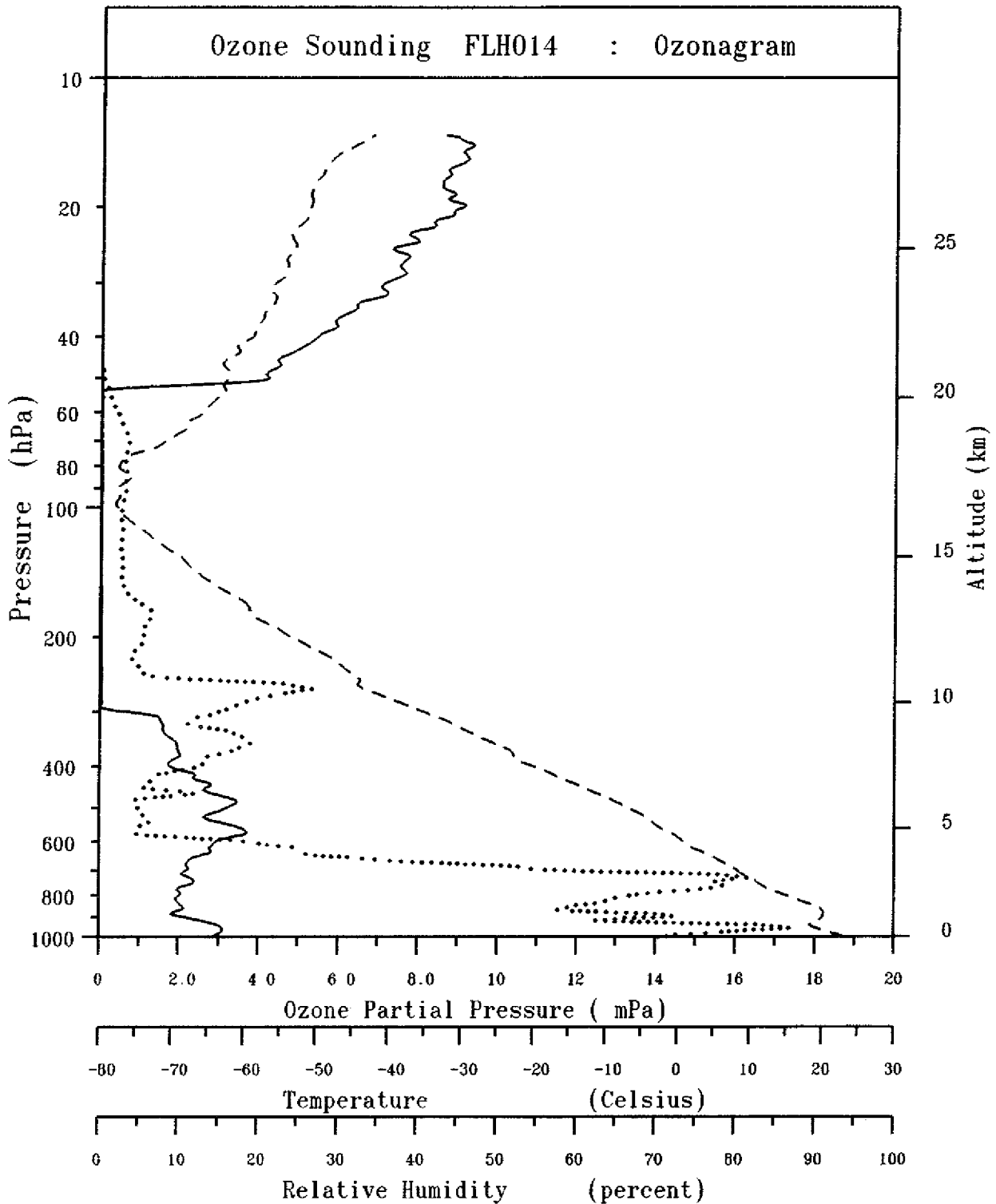
— Ozone

- - - Temperature

..... Relative Humidity



Date	03-04-1987	—	Ozone
Time at launch	23:10 (UTC)	- - - -	Temperature
Location	5:06 N , 30:00 W	.....	Relative Humidity



Date 05-04-1987

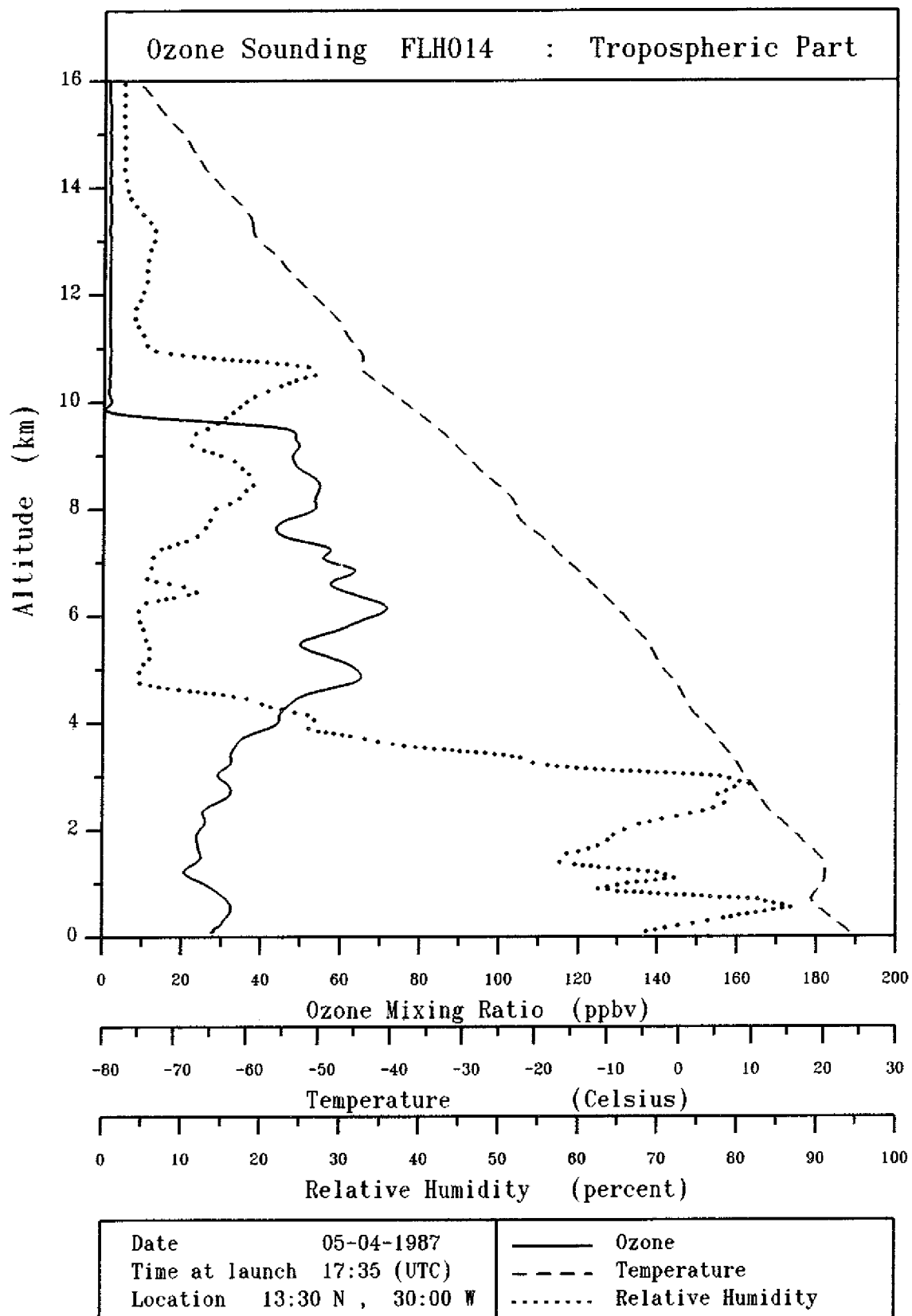
Time at launch 17:35 (UTC)

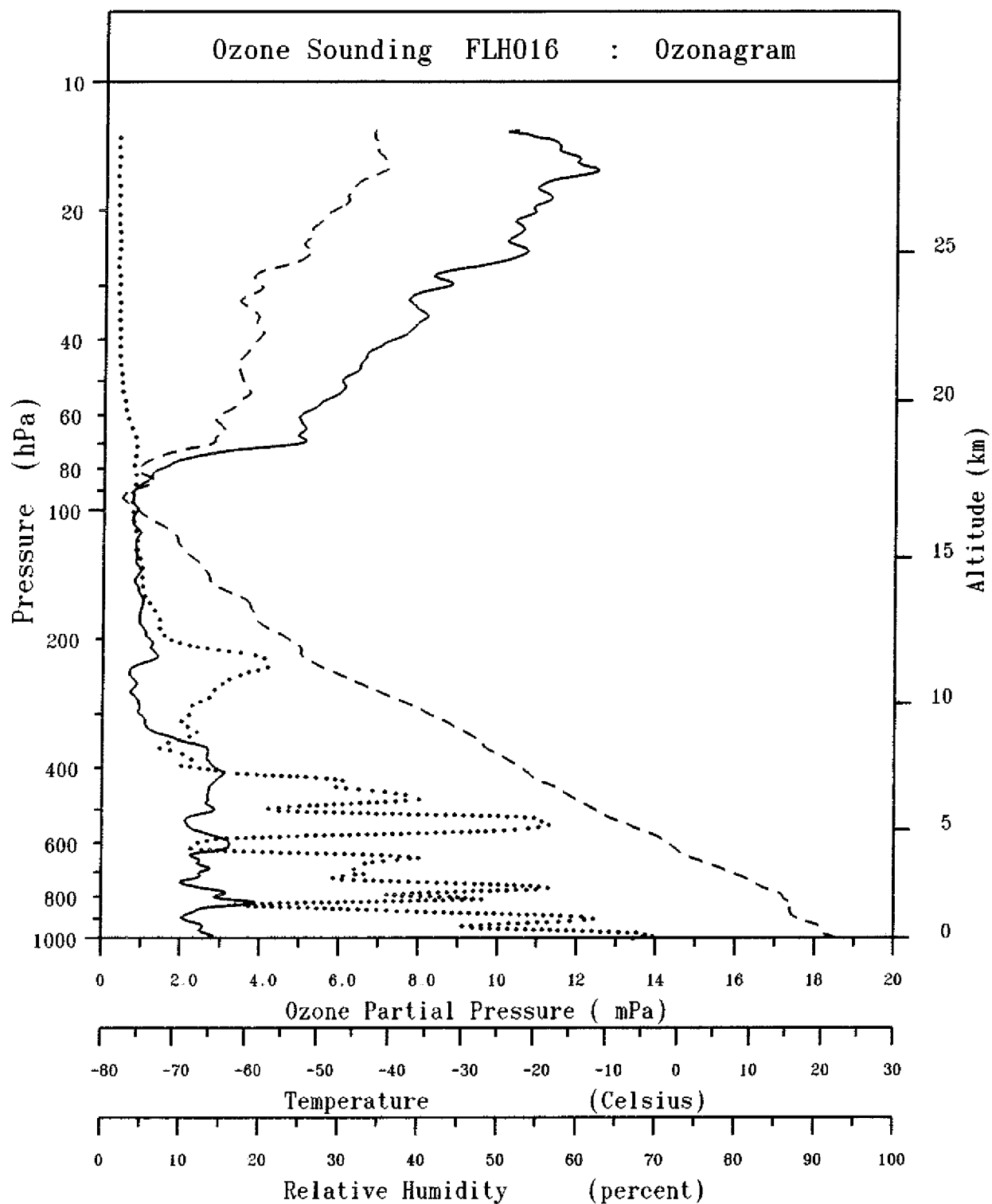
Location 13:30 N , 30:00 W

—— Ozone

--- Temperature

..... Relative Humidity





Date 06-04-1987

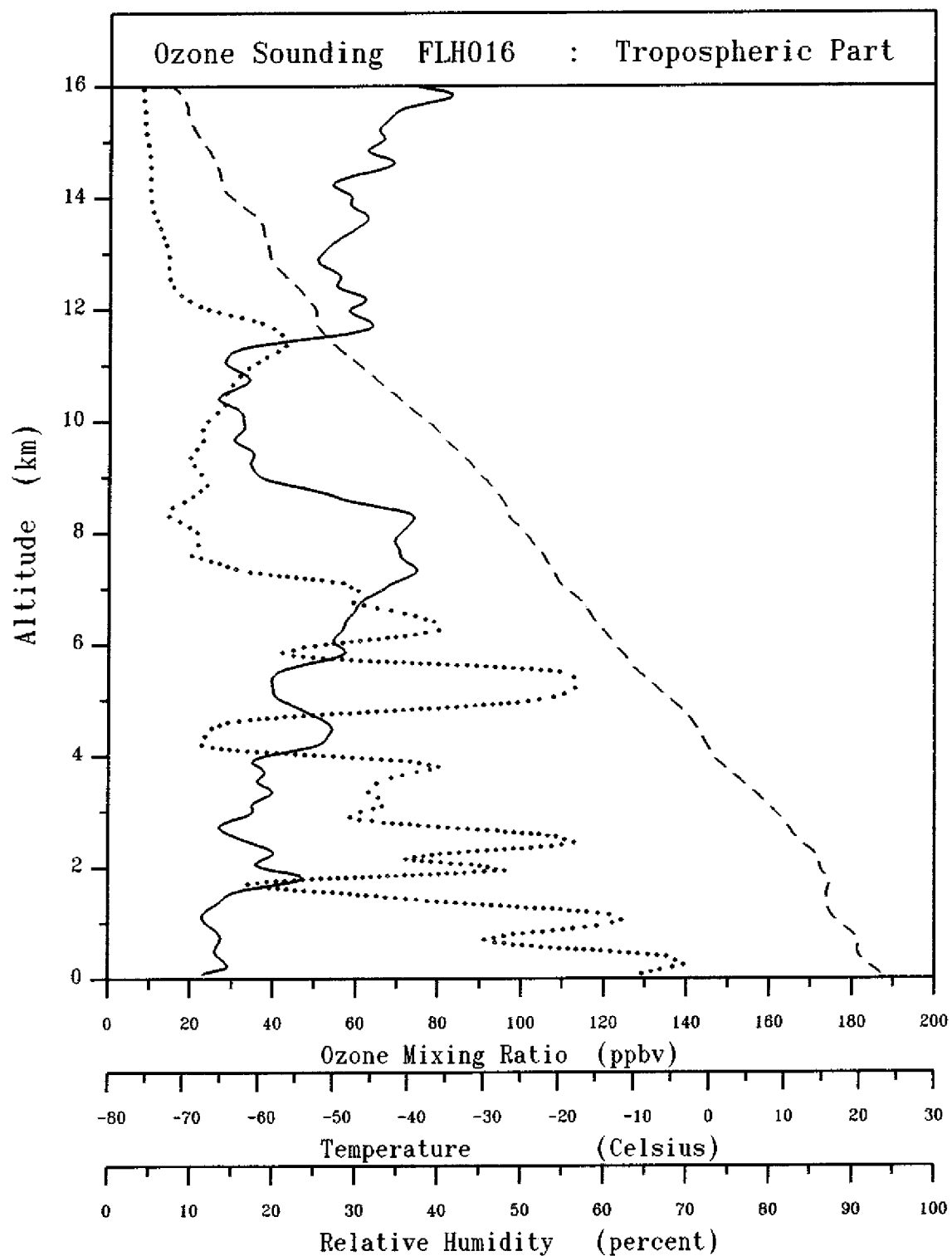
Time at launch 15:35 (UTC)

Location 18:18 N , 30:00 W

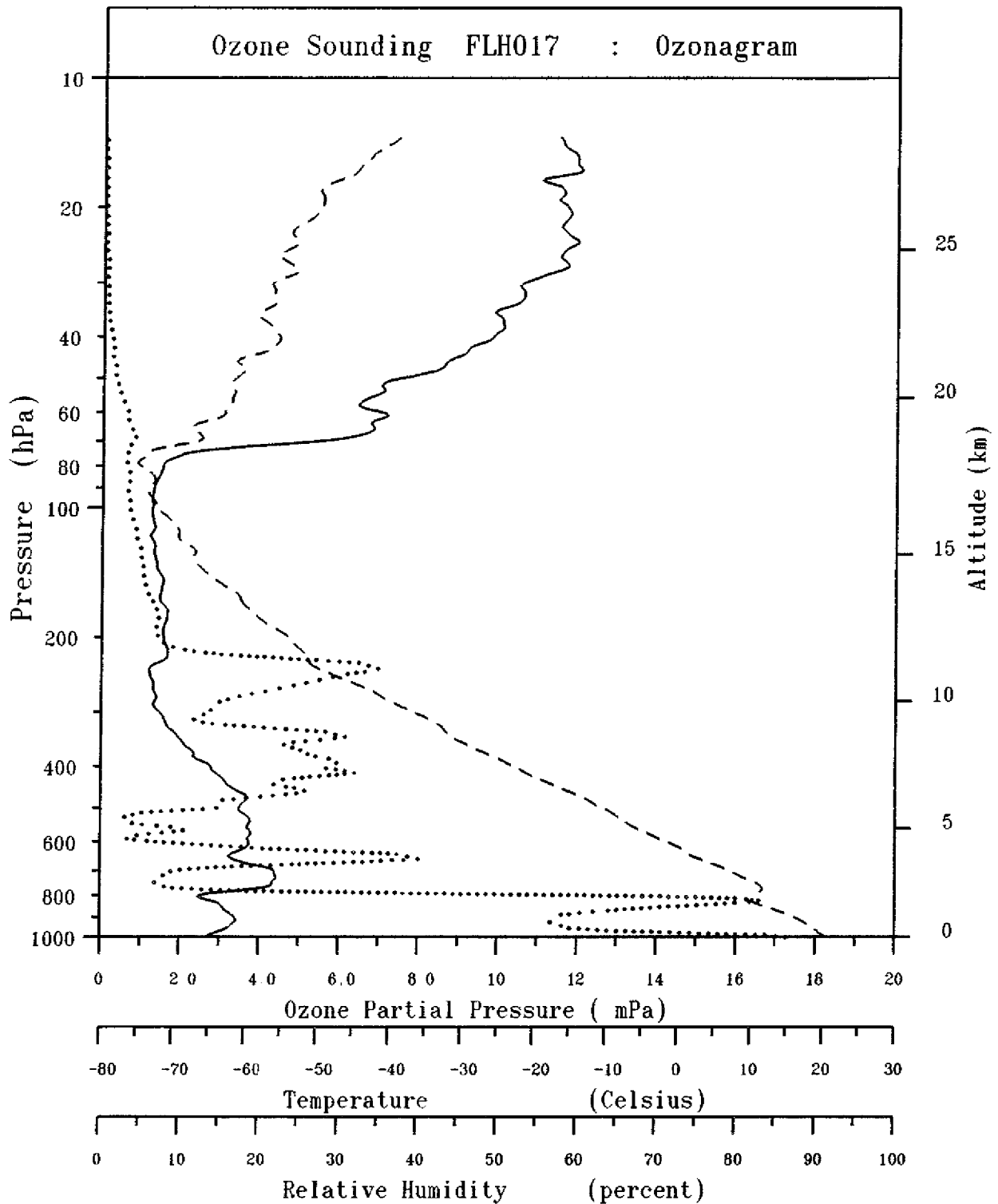
— Ozone

--- Temperature

..... Relative Humidity



Date	06-04-1987	—	Ozone
Time at launch	15:35 (UTC)	- - -	Temperature
Location	18:18 N , 30:00 W	.....	Relative Humidity



Date 07-04-1987

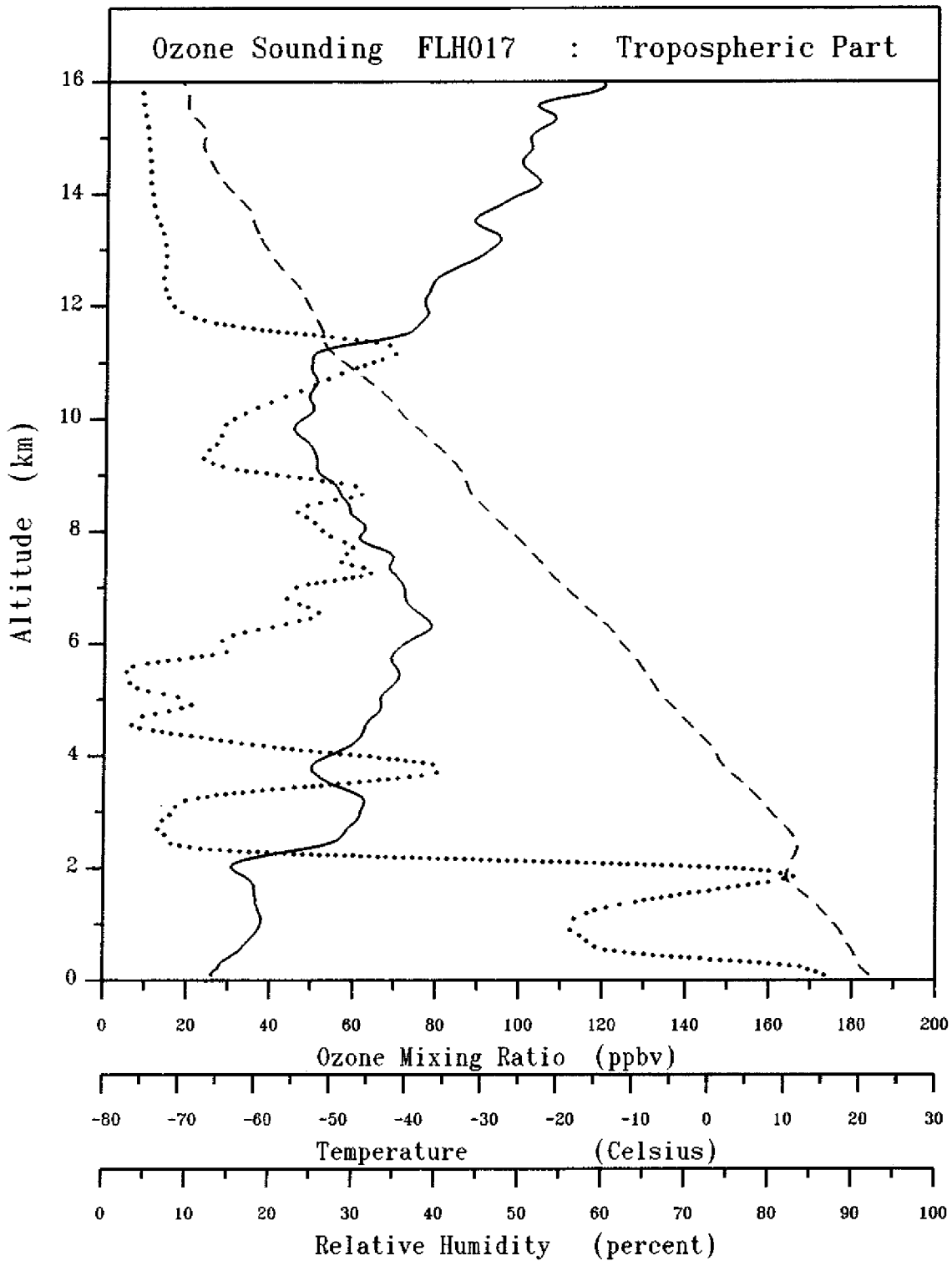
Time at launch 01:00 (UTC)

Location 19:24 N , 30:00 W

— Ozone

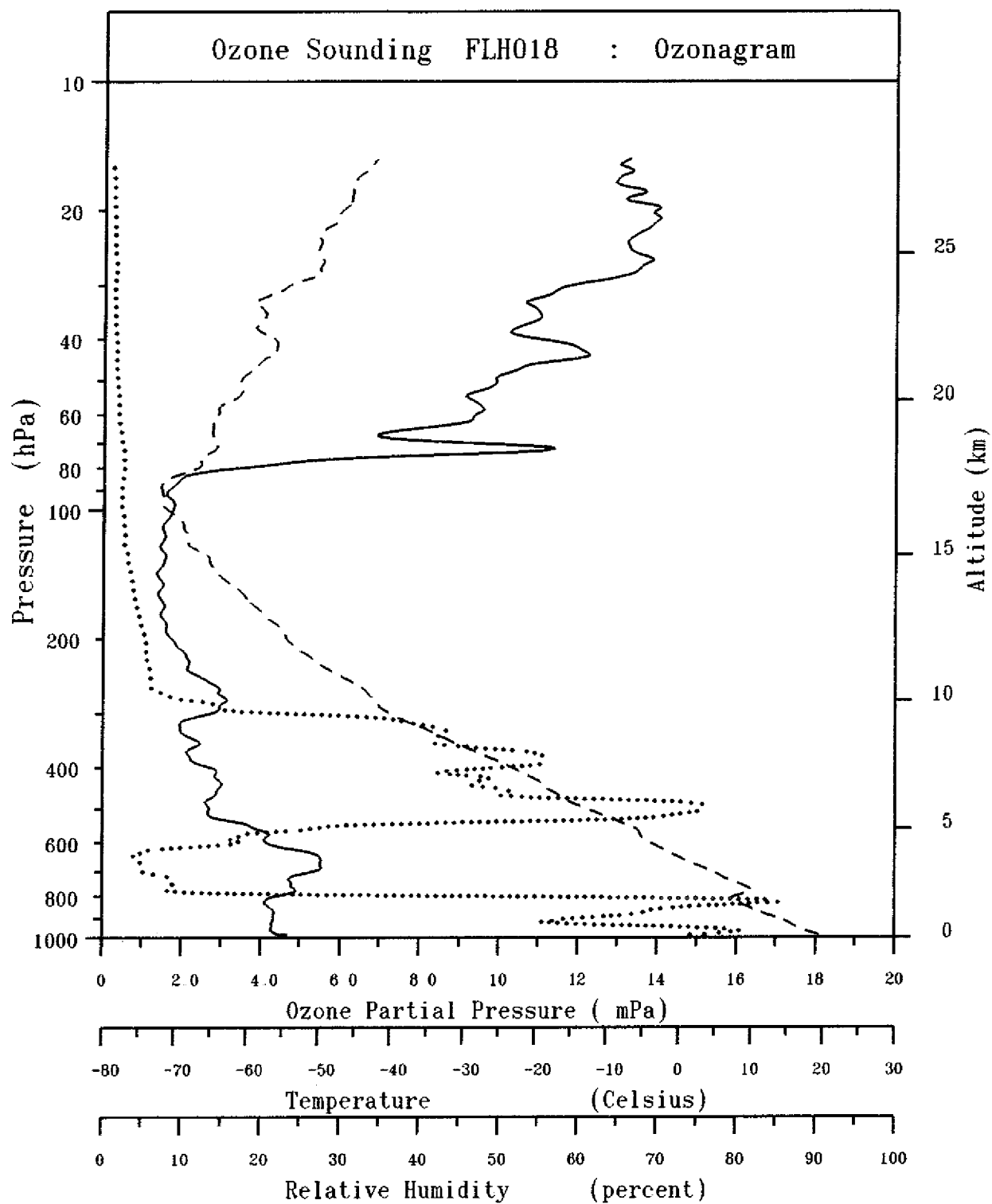
- - - Temperature

..... Relative Humidity

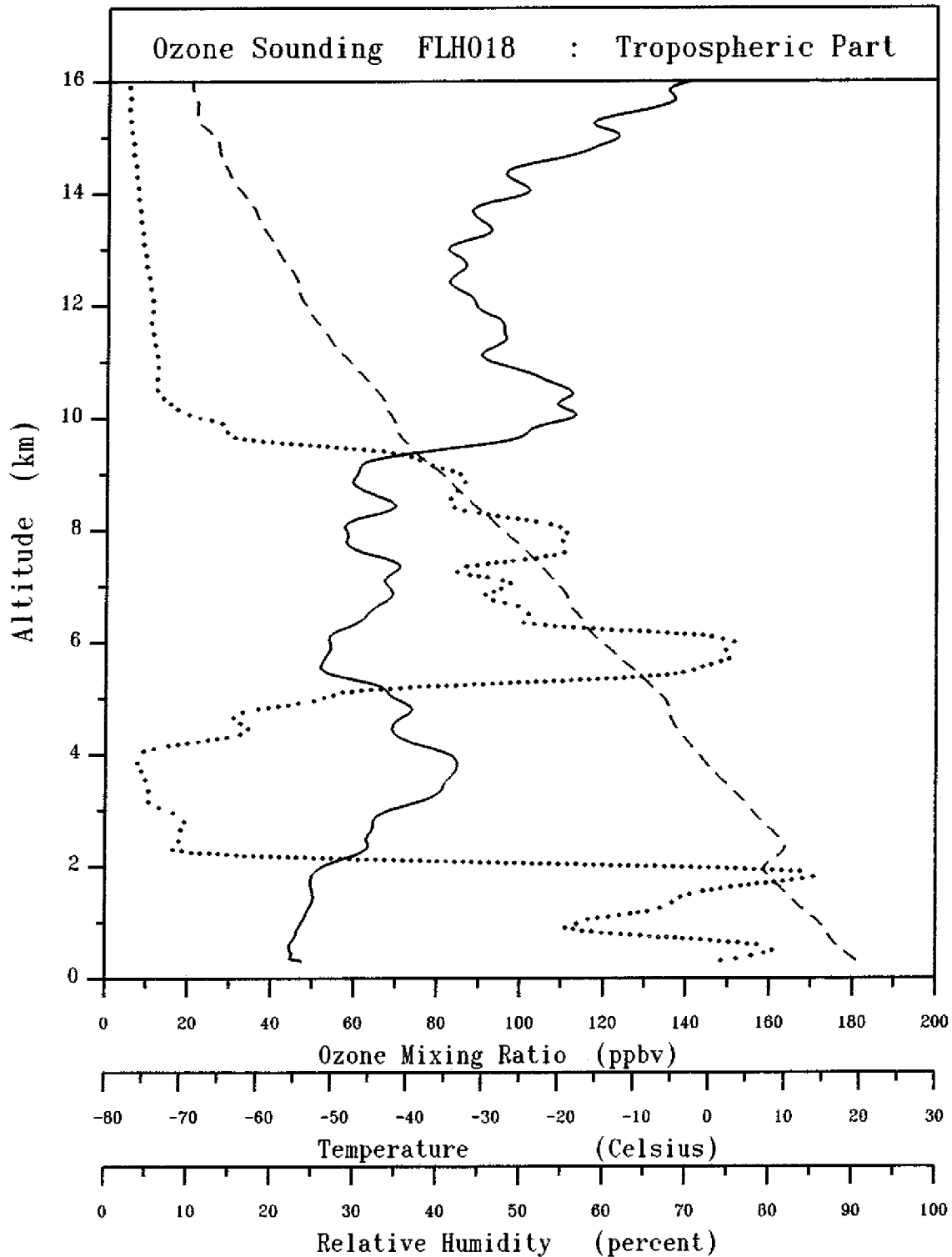


Date 07-04-1987
 Time at launch 01:00 (UTC)
 Location 19:24 N , 30:00 W

— Ozone
 - - - Temperature
 Relative Humidity

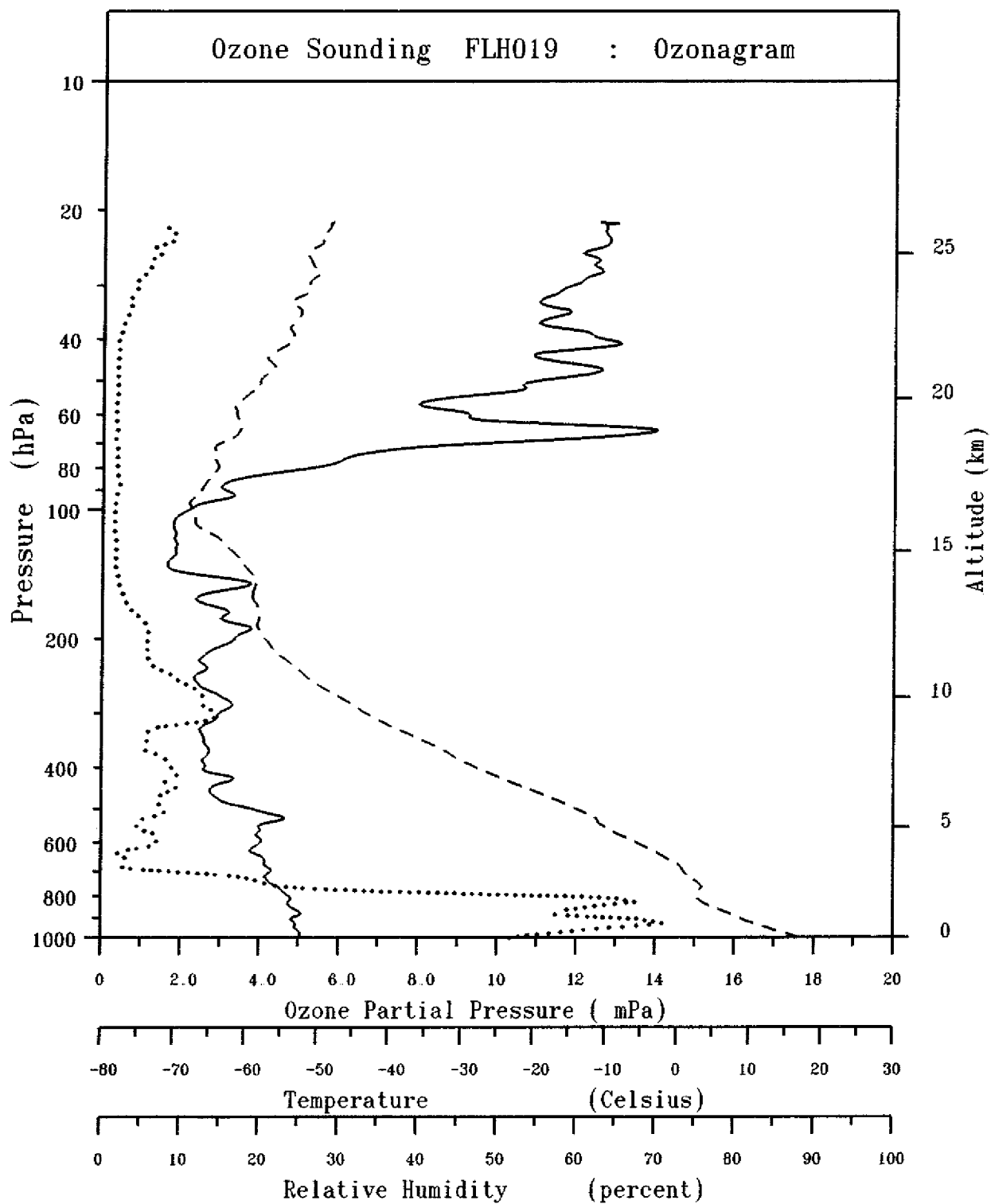


Date	07-04-1987	—	Ozone
Time at launch	15:28 (UTC)	- - -	Temperature
Location	22:48 N , 30:00 W	.....	Relative Humidity



Date 07-04-1987
 Time at launch 15:28 (UTC)
 Location 22:48 N , 30:00 W

— Ozone
 - - - Temperature
 Relative Humidity



Date 08-04-1987

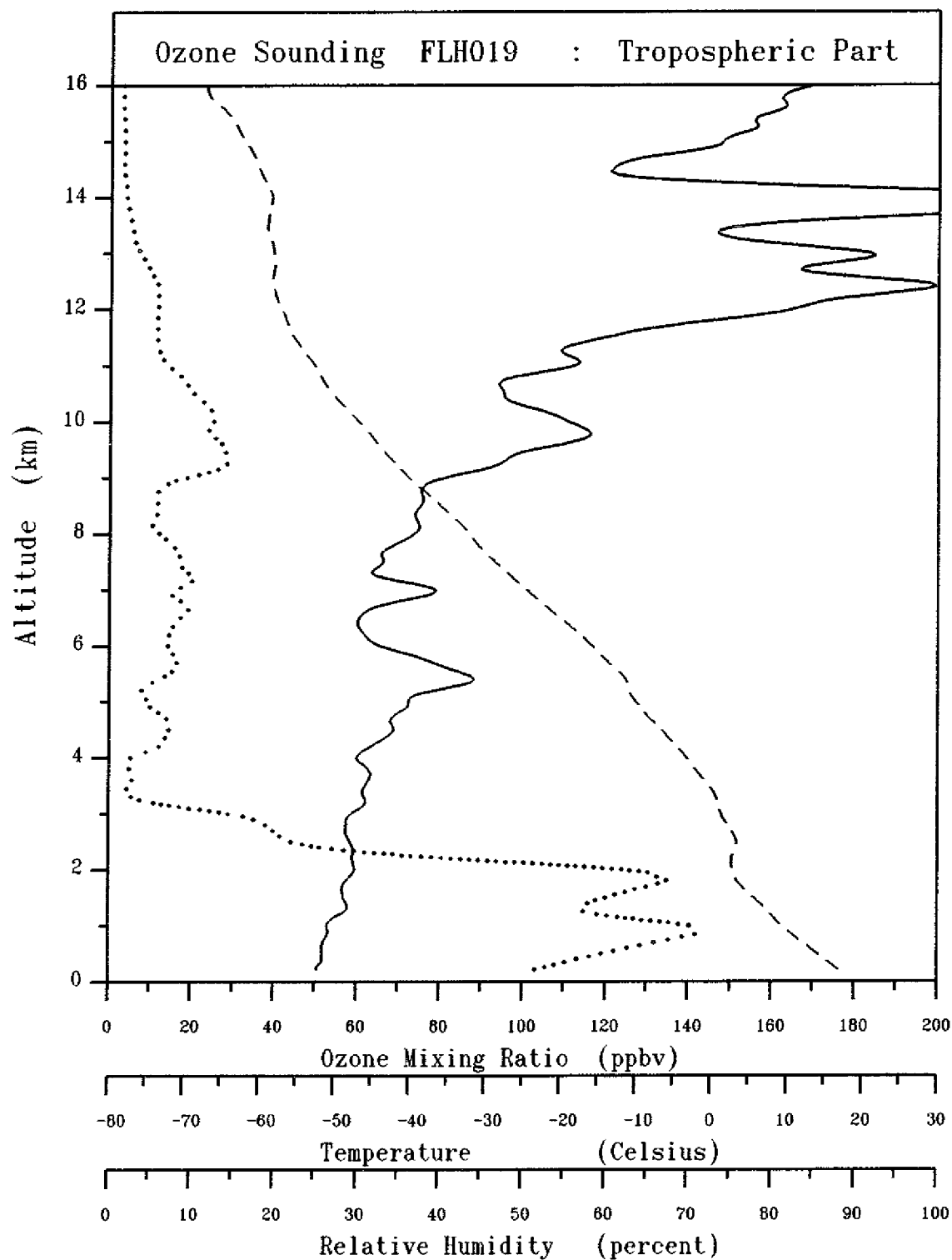
Time at launch 15:35 (UTC)

Location 27:18 N , 30:00 W

— Ozone

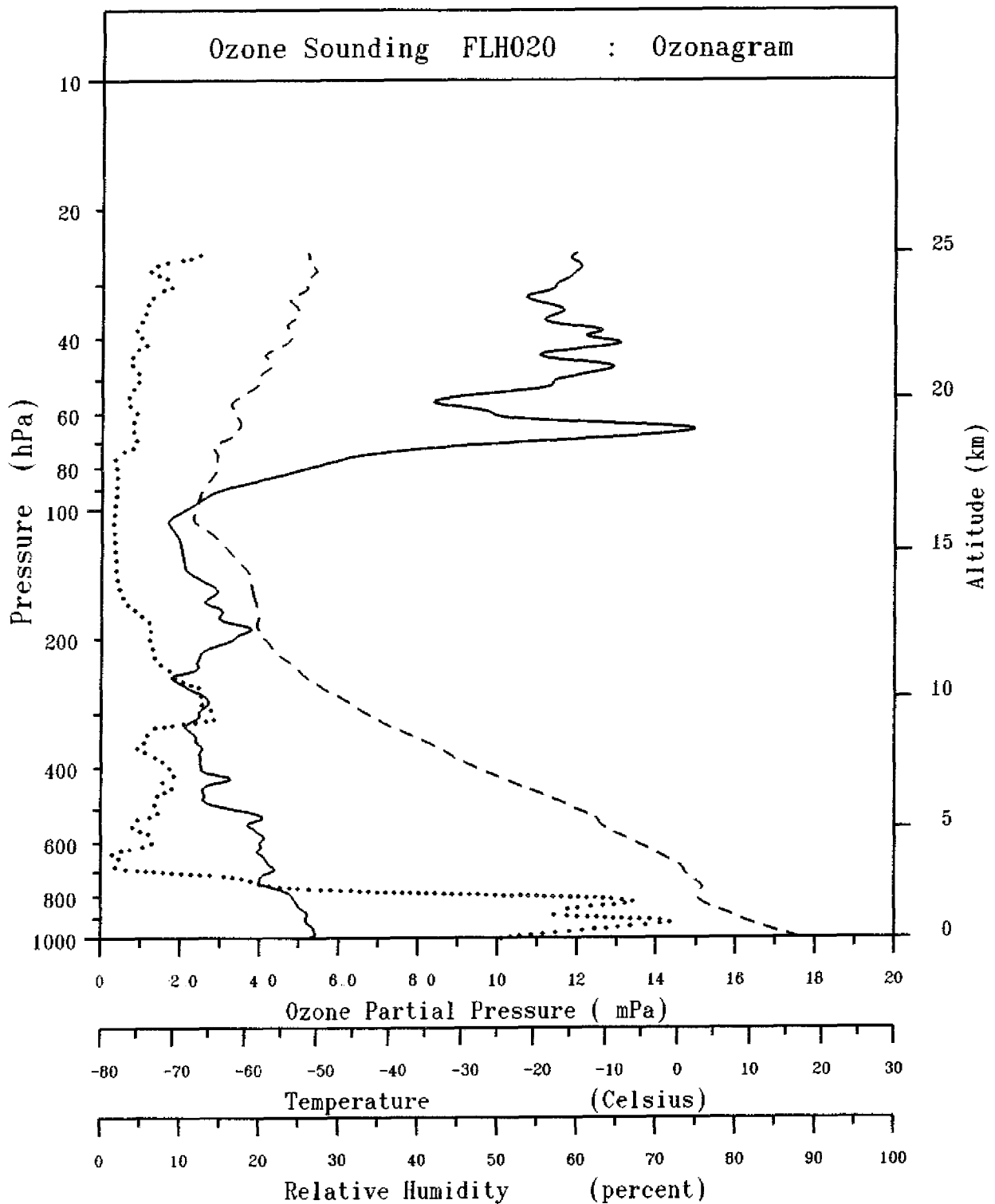
--- Temperature

..... Relative Humidity

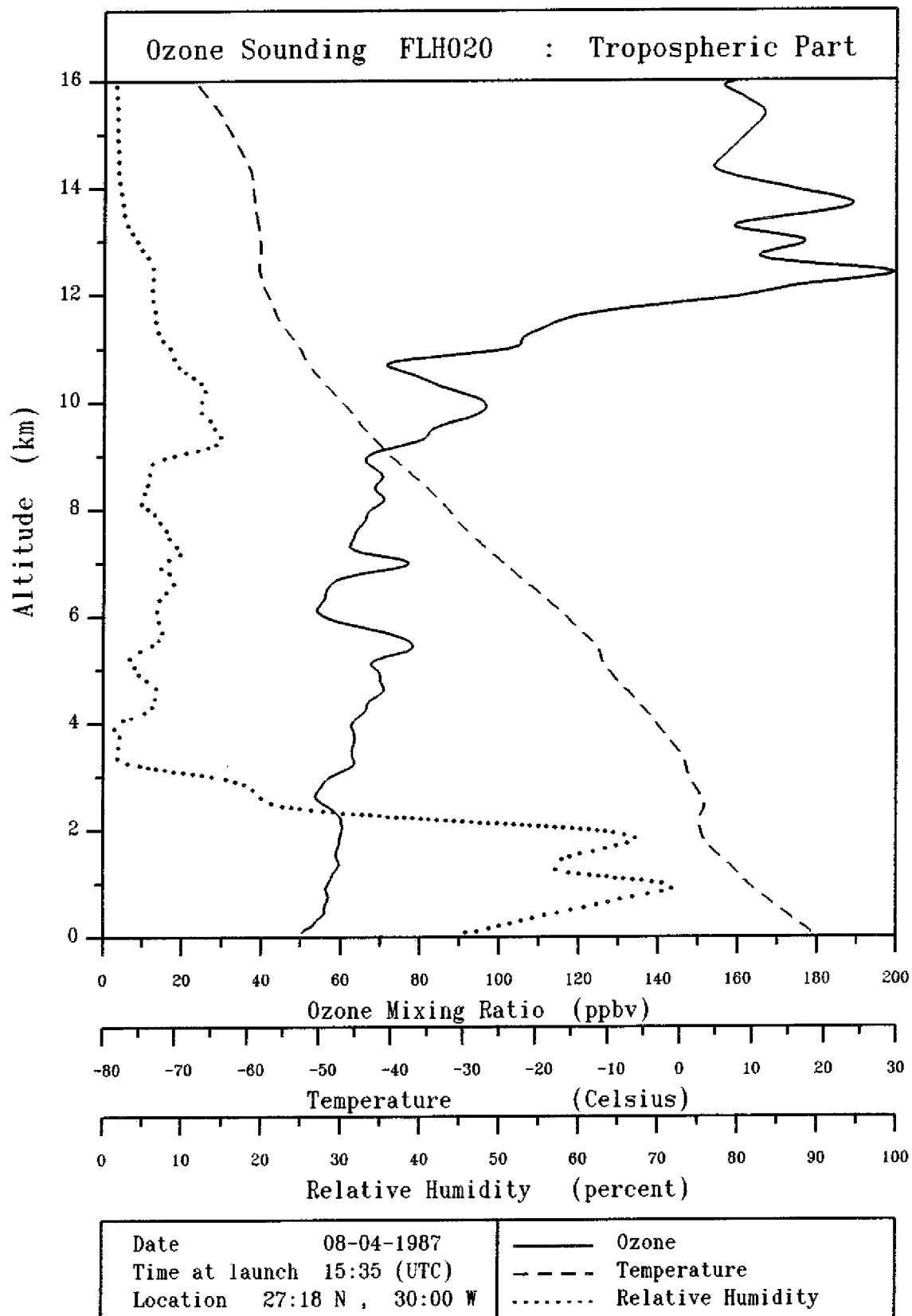


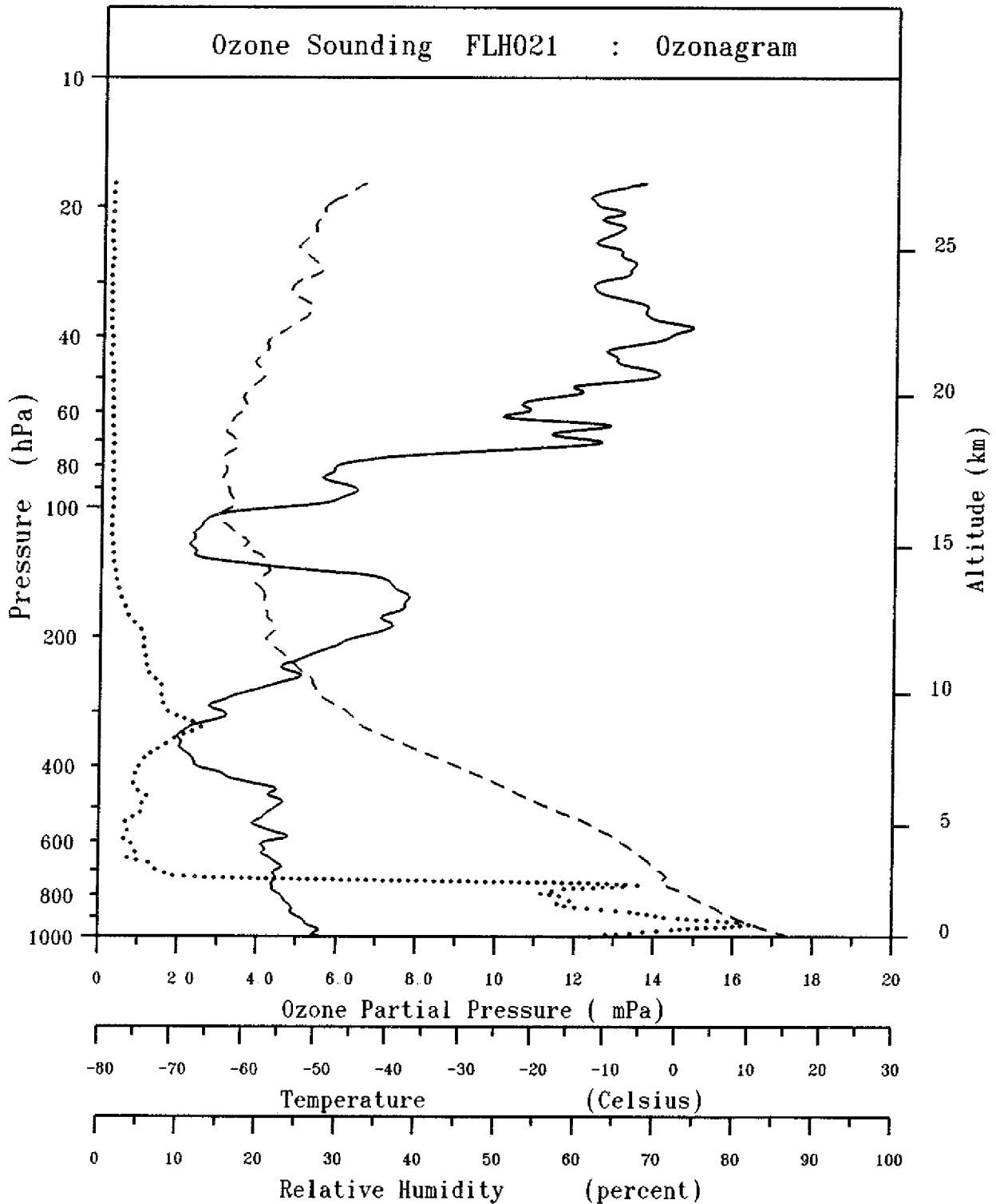
Date 08-04-1987
 Time at launch 15:35 (UTC)
 Location 27:18 N , 30:00 W

— Ozone
 --- Temperature
 Relative Humidity



Date	08-04-1987	—	Ozone
Time at launch	15:35 (UTC)	- - - -	Temperature
Location	27:18 N , 30:00 W	.....	Relative Humidity





Date 09-04-1987

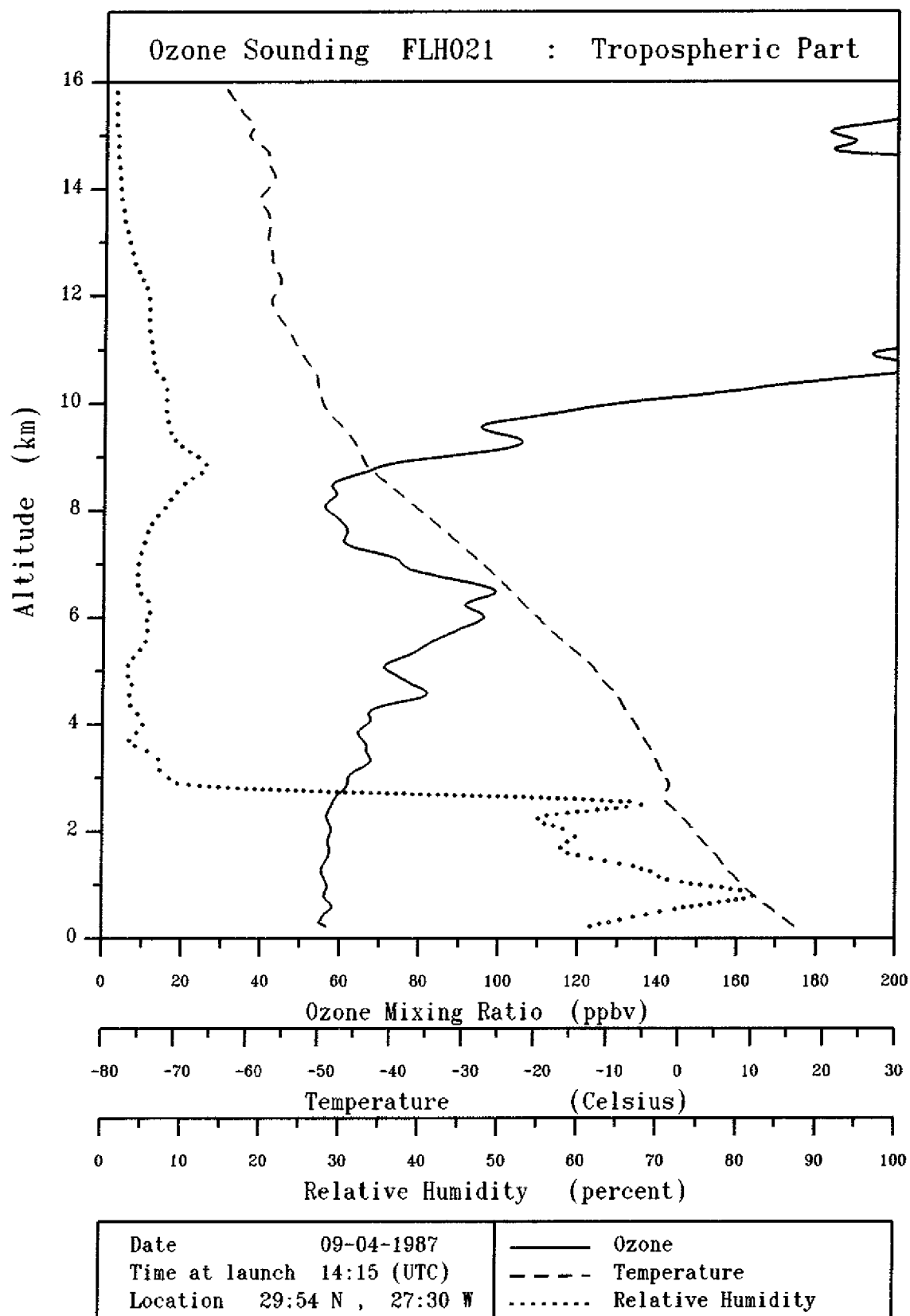
Time at launch 14:15 (UTC)

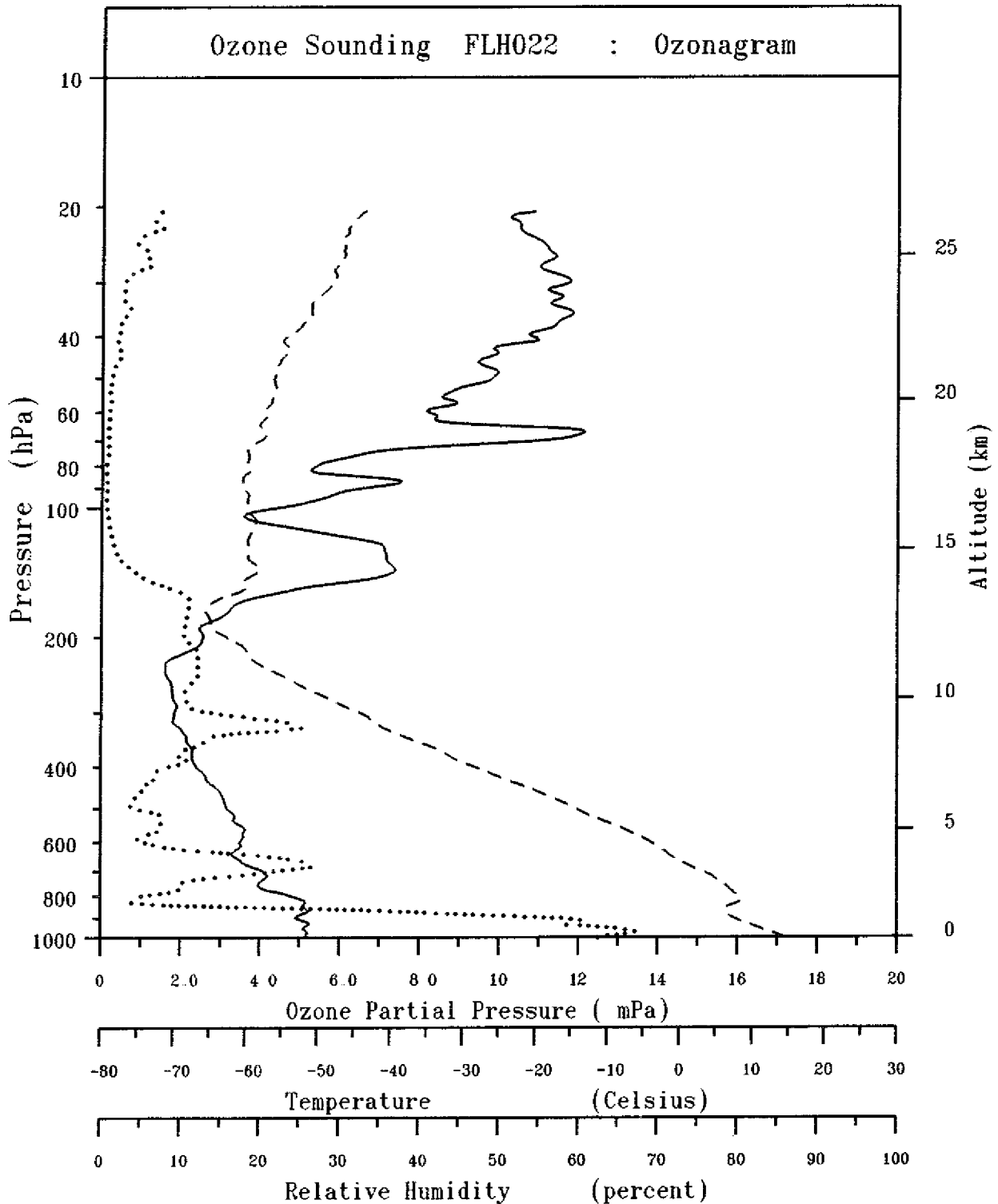
Location 29:54 N , 27:30 W

— Ozone

- - - Temperature

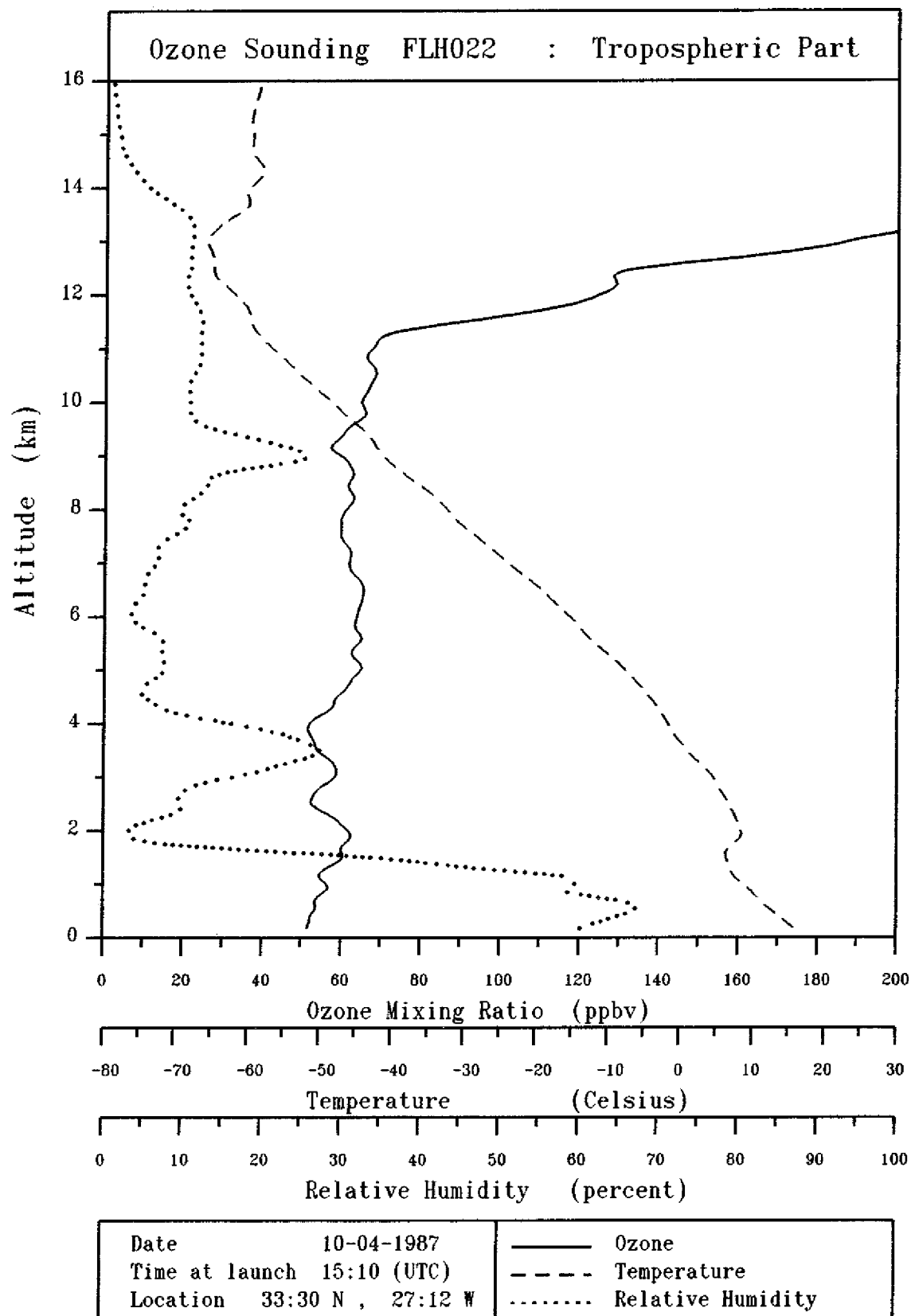
..... Relative Humidity

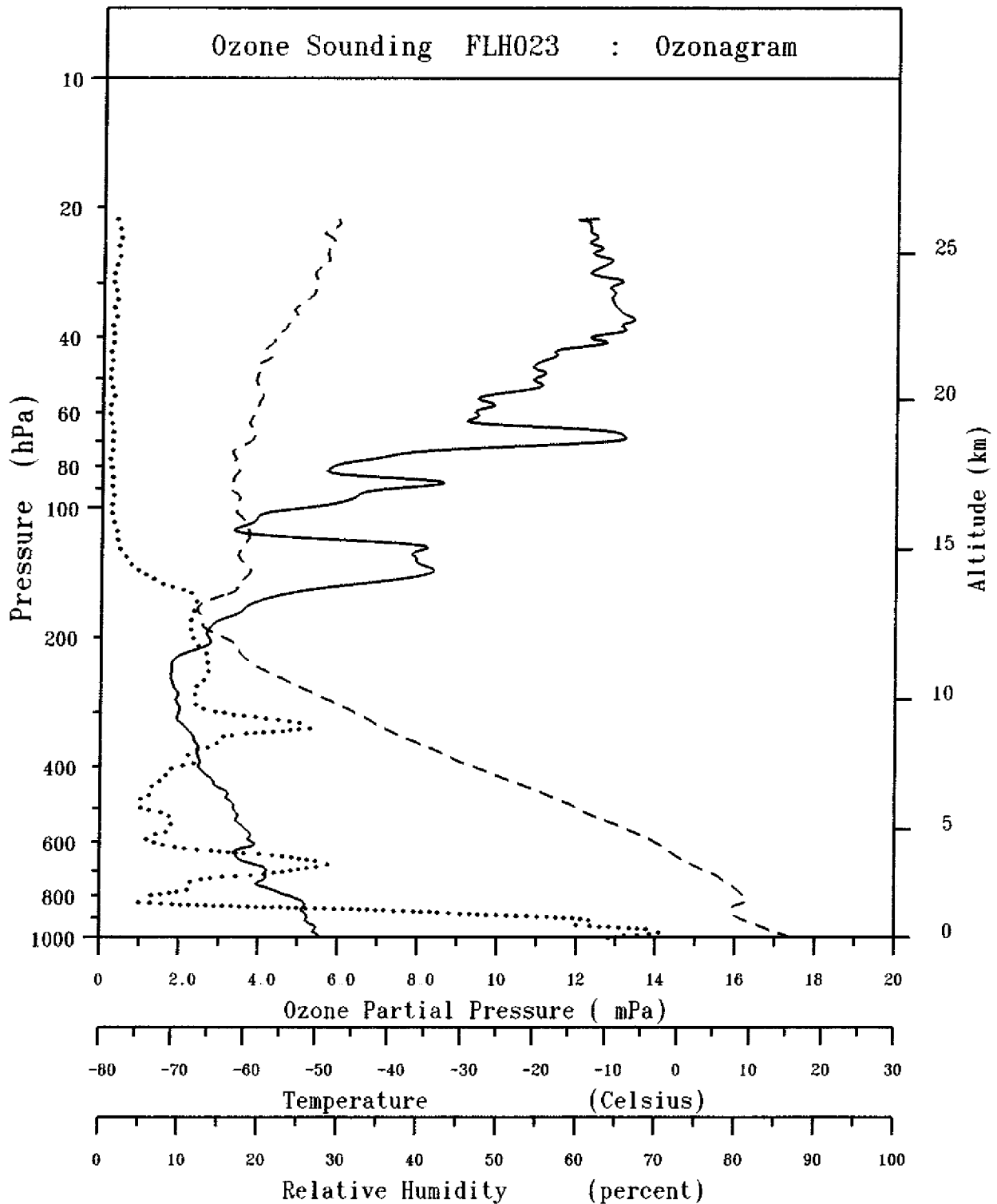




Date 10-04-1987
 Time at launch 15:10 (UTC)
 Location 33:30 N , 27:12 W

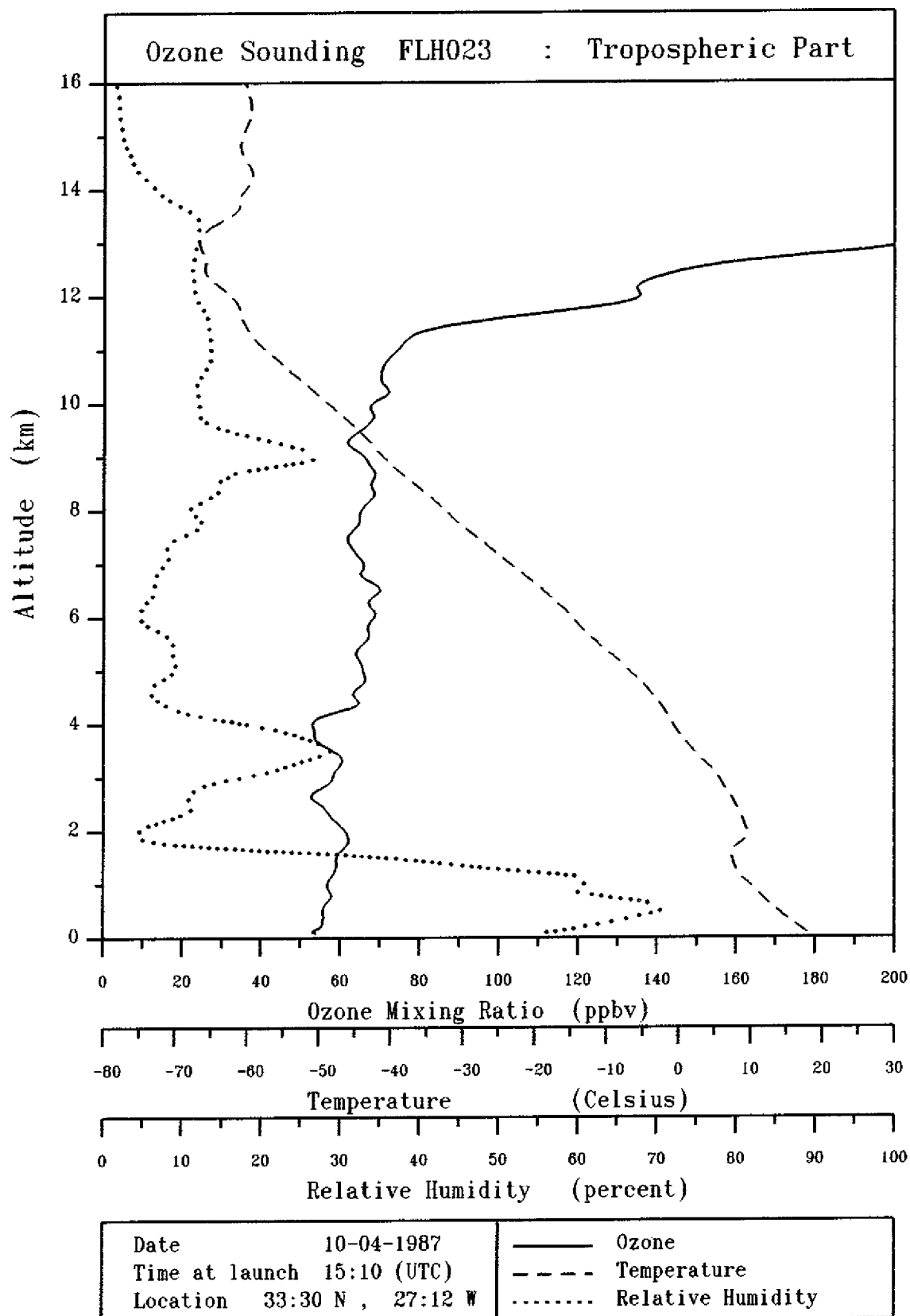
— Ozone
 --- Temperature
 Relative Humidity

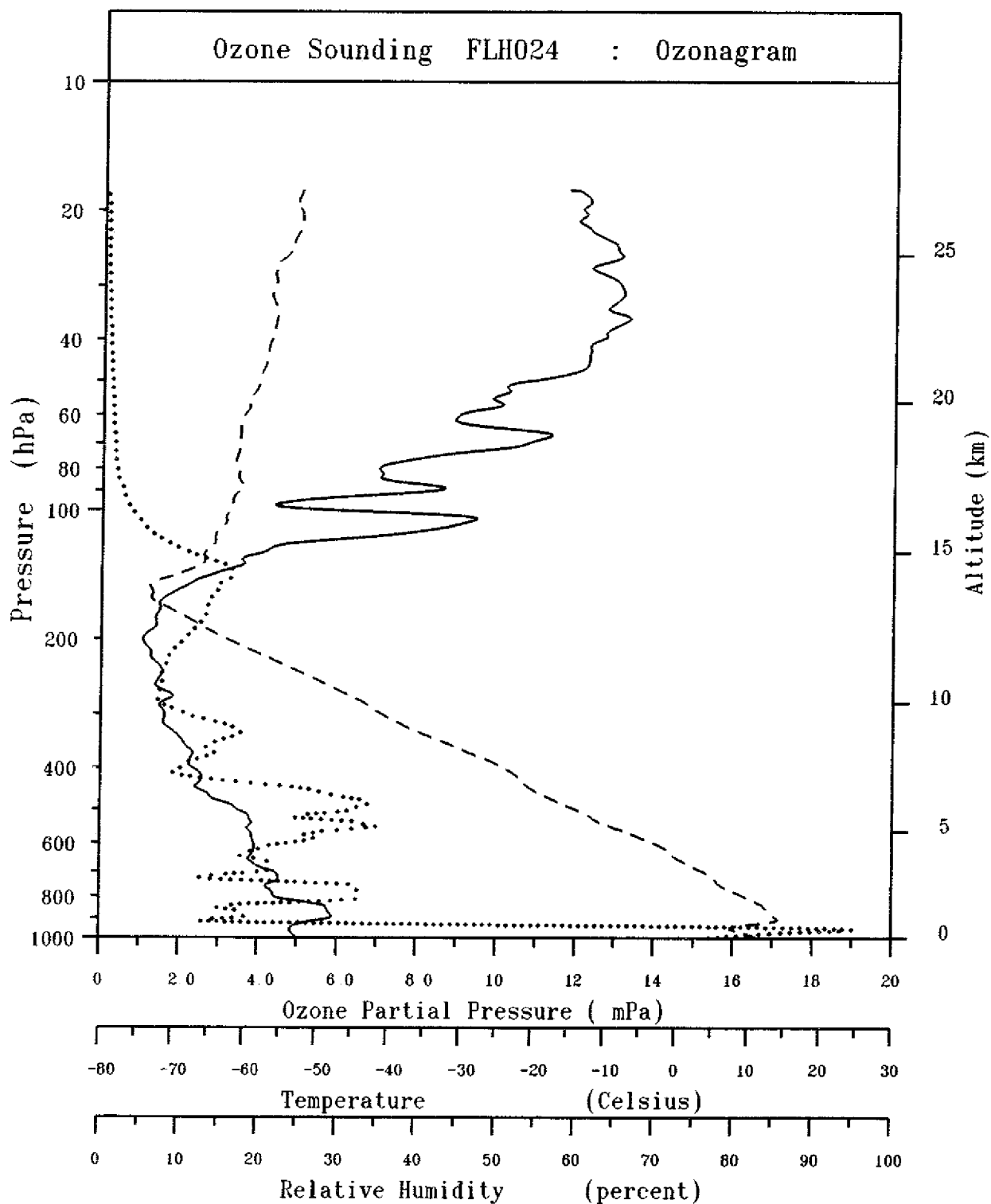




Date 10-04-1987
 Time at launch 15:10 (UTC)
 Location 33:30 N , 27:12 W

— Ozone
 --- Temperature
 Relative Humidity





Date 12-04-1987

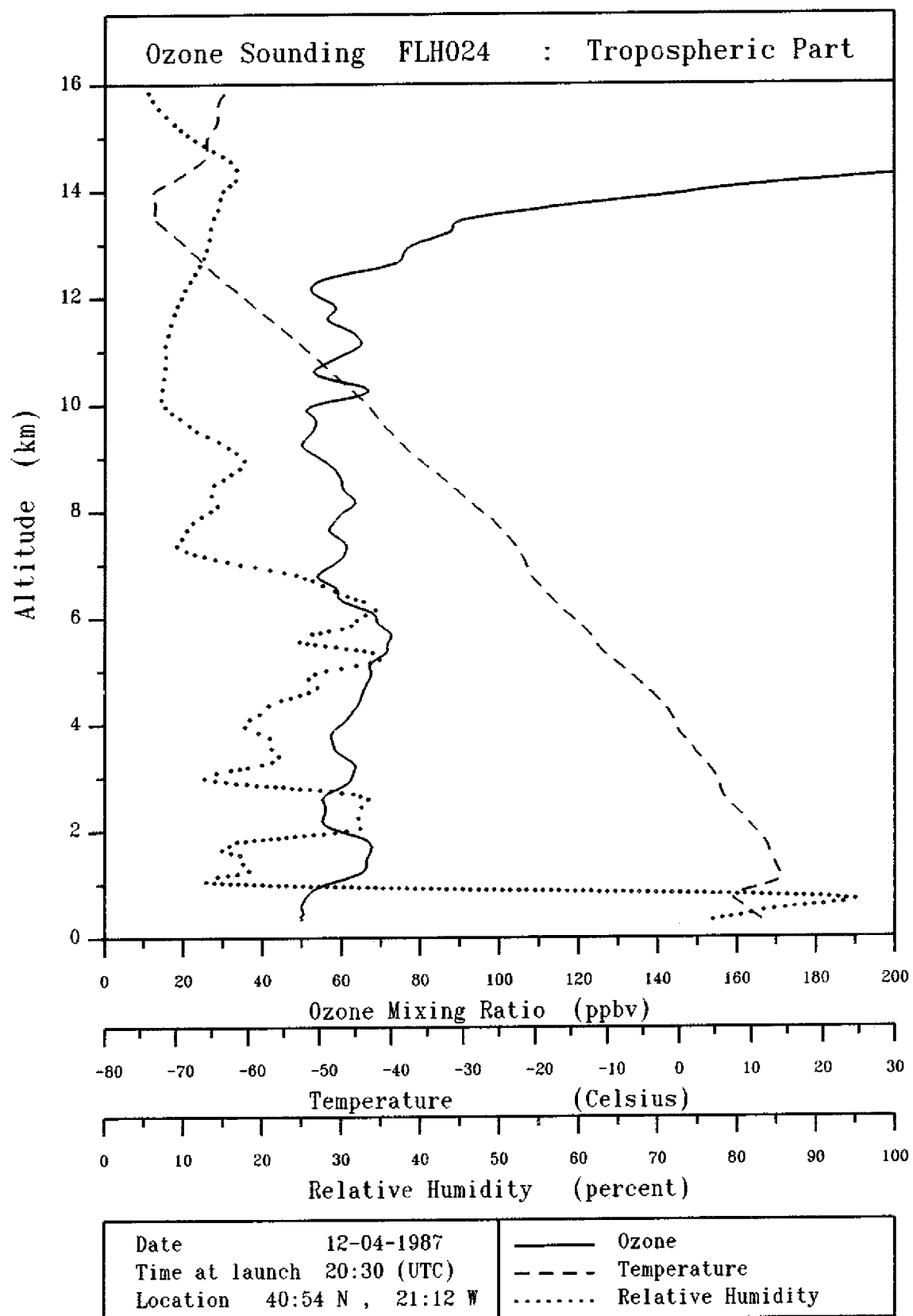
Time at launch 20:30 (UTC)

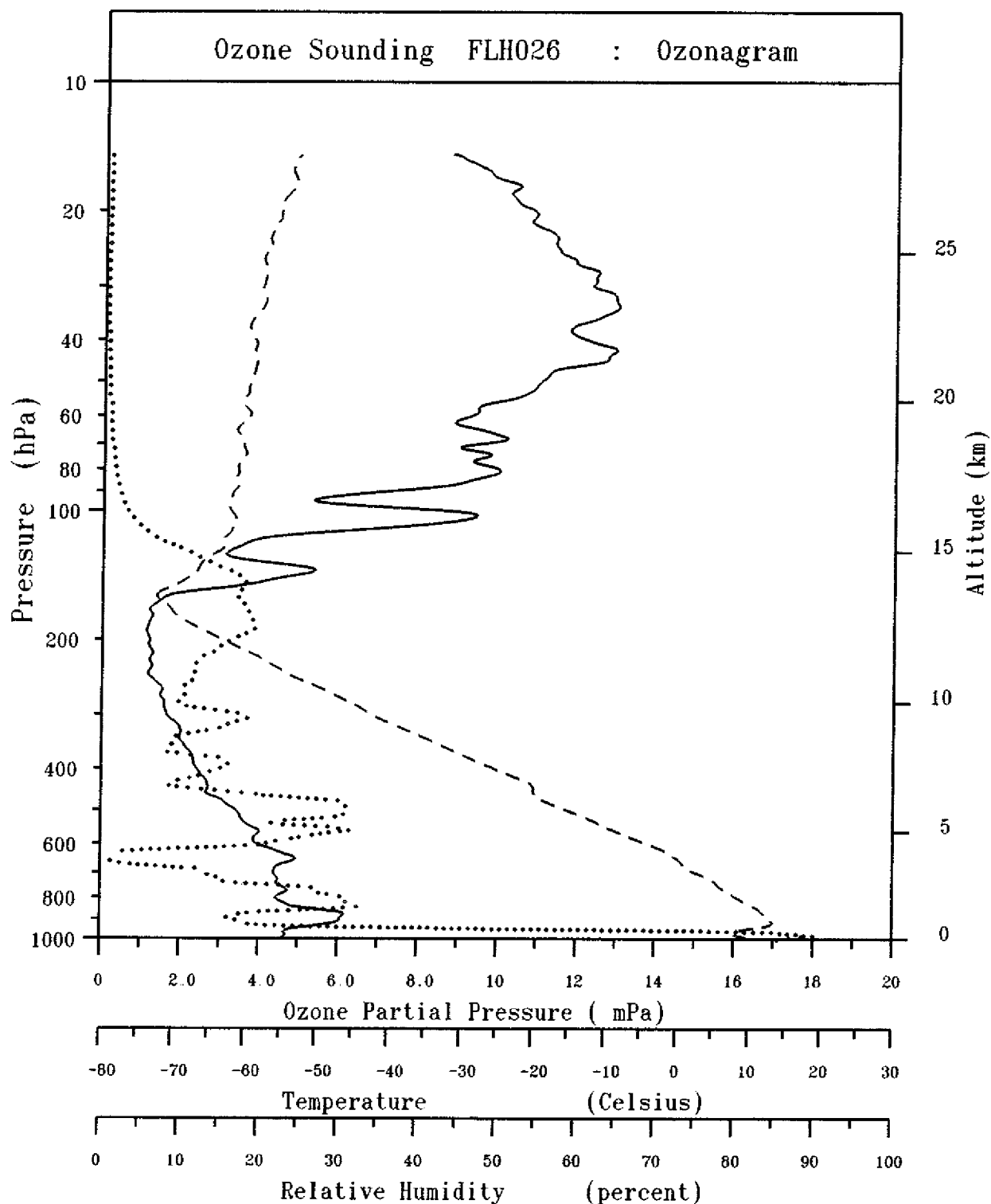
Location 40:54 N , 21:12 W

— Ozone

- - - Temperature

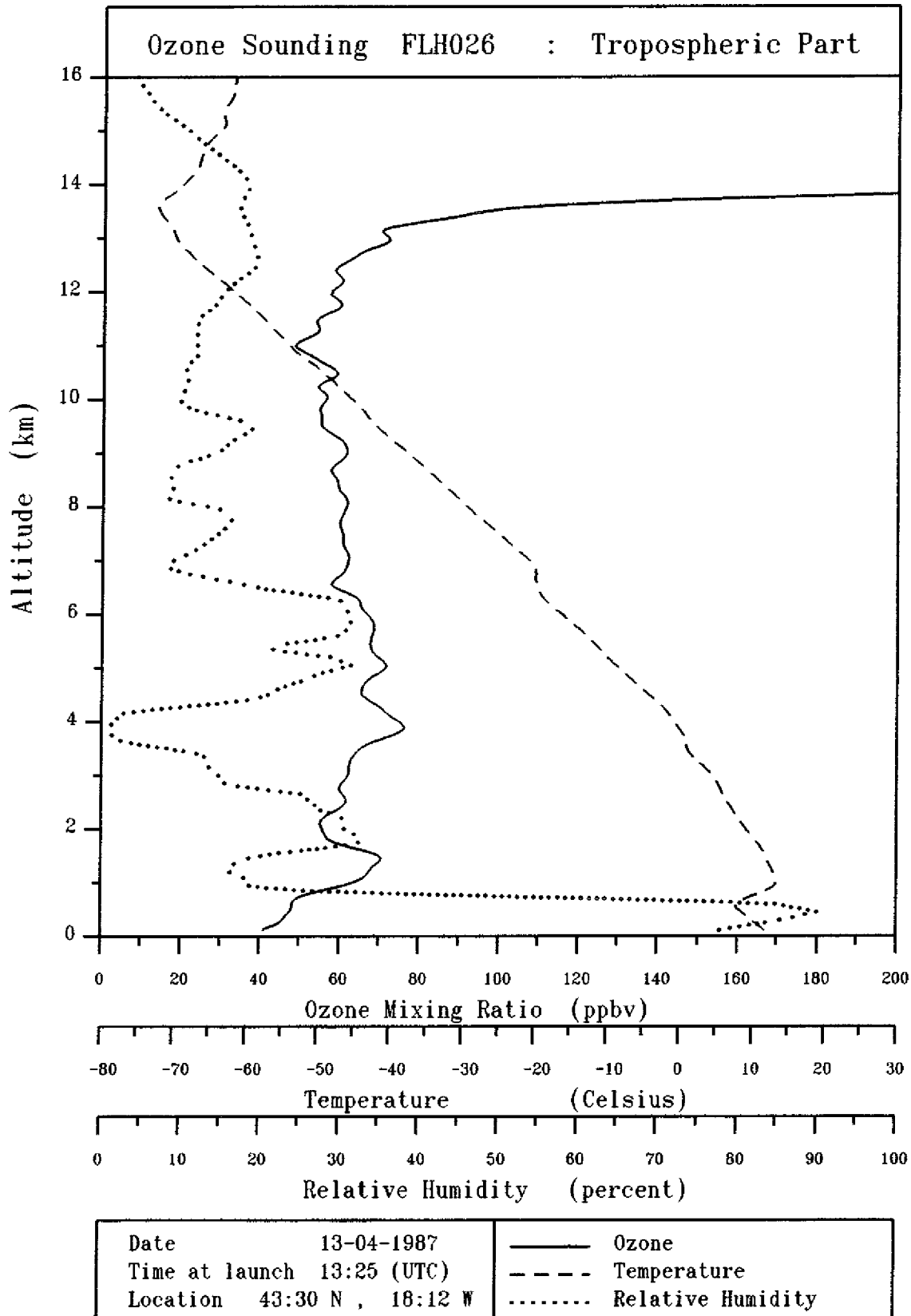
..... Relative Humidity

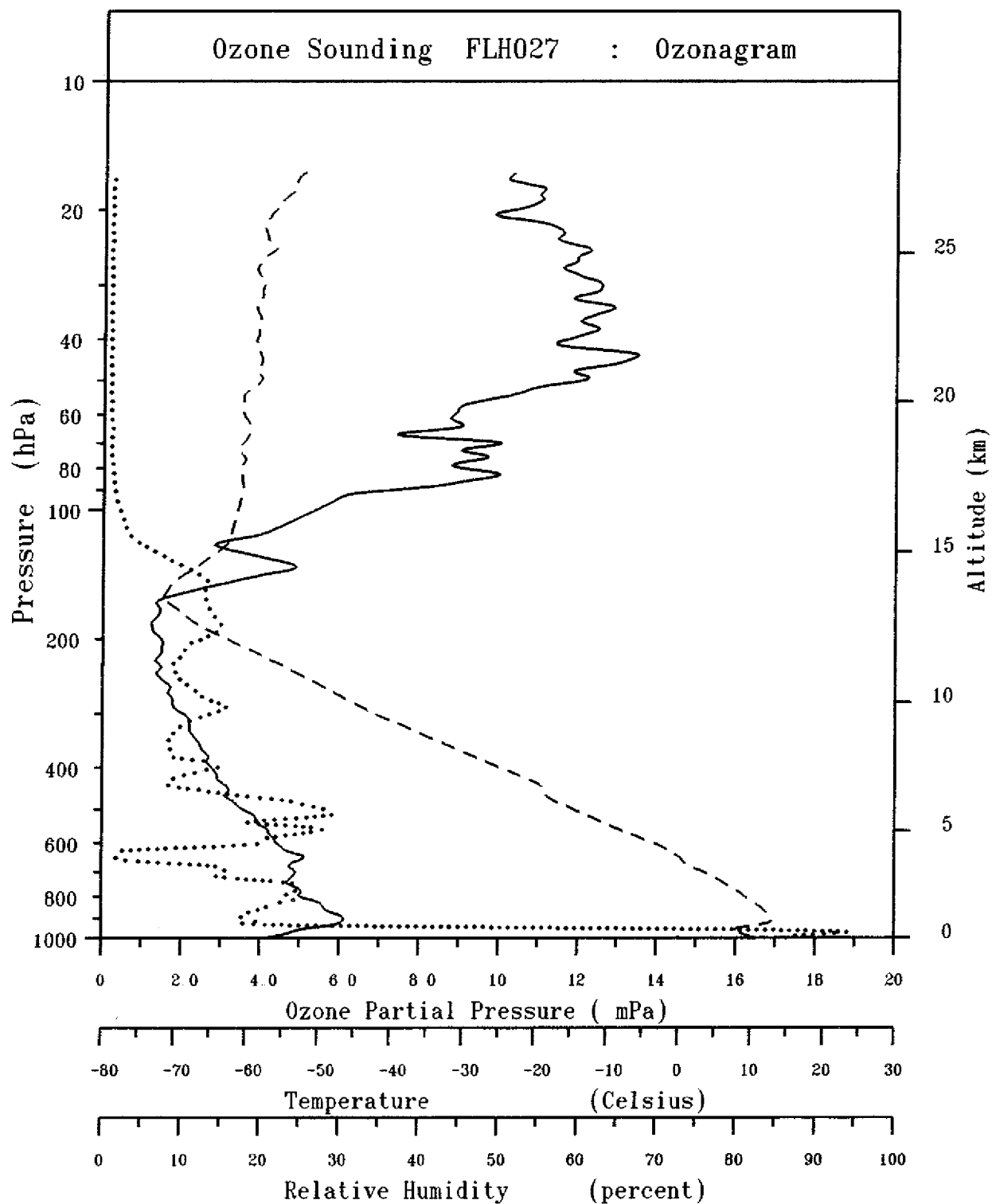




Date 13-04-1987
 Time at launch 13:25 (UTC)
 Location 43:30 N , 18:12 W

— Ozone
 --- Temperature
 Relative Humidity





Date 13-04-1987

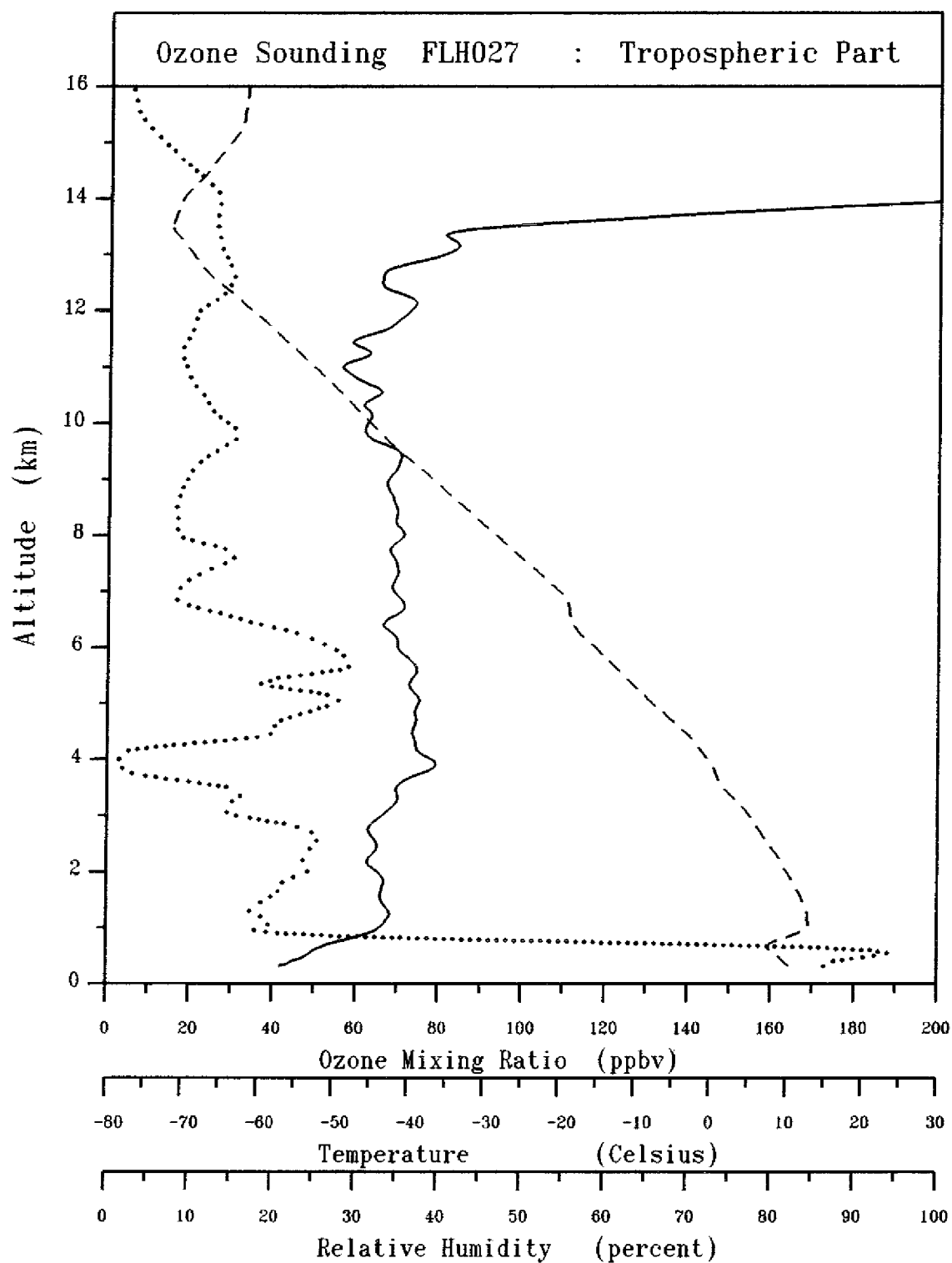
Time at launch 17:35 (UTC)

Location 44:18 N , 17:12 W

— Ozone

- - - Temperature

..... Relative Humidity



Date 13-04-1987

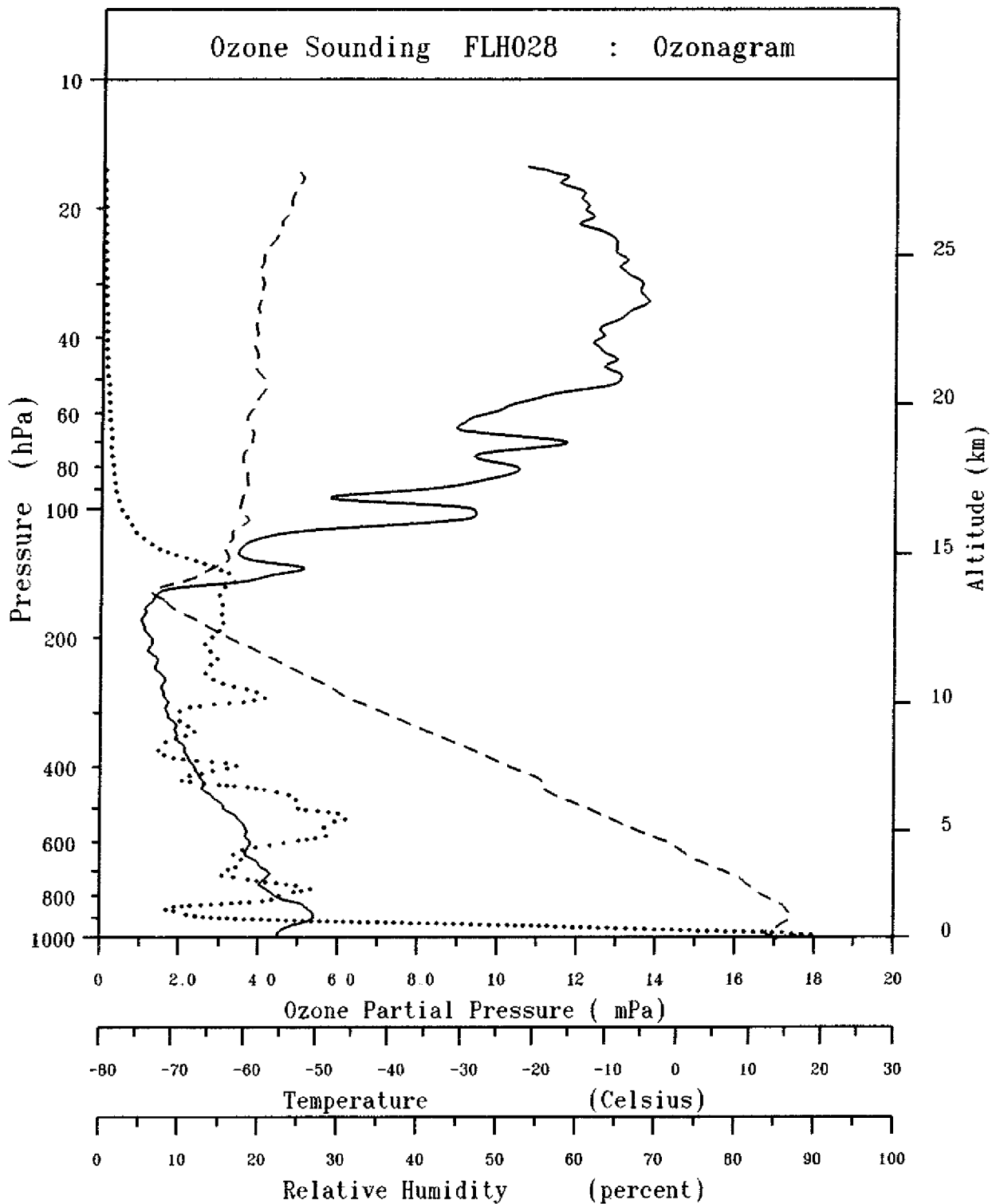
Time at launch 17:35 (UTC)

Location 44:18 N , 17:12 W

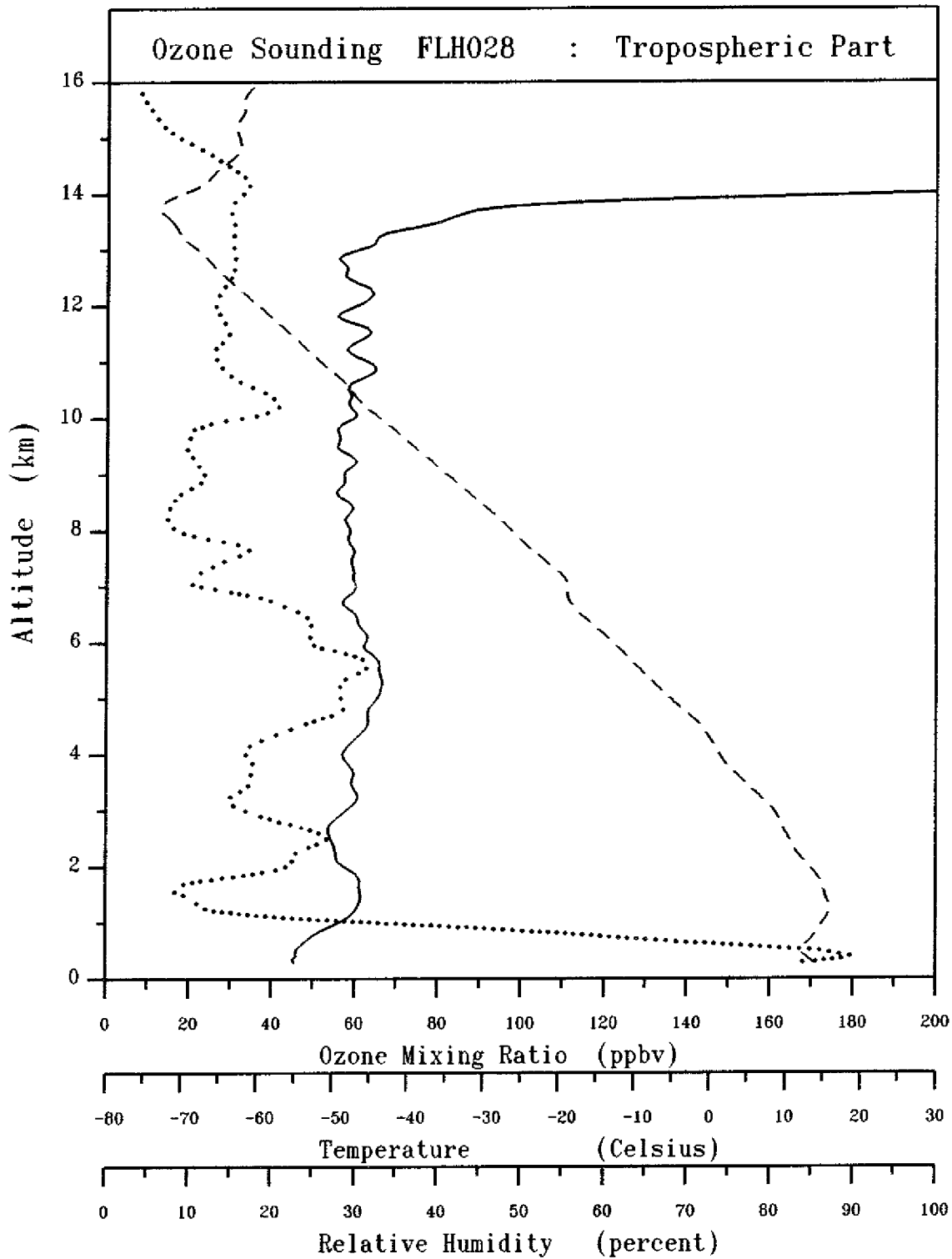
— Ozone

- - - Temperature

..... Relative Humidity

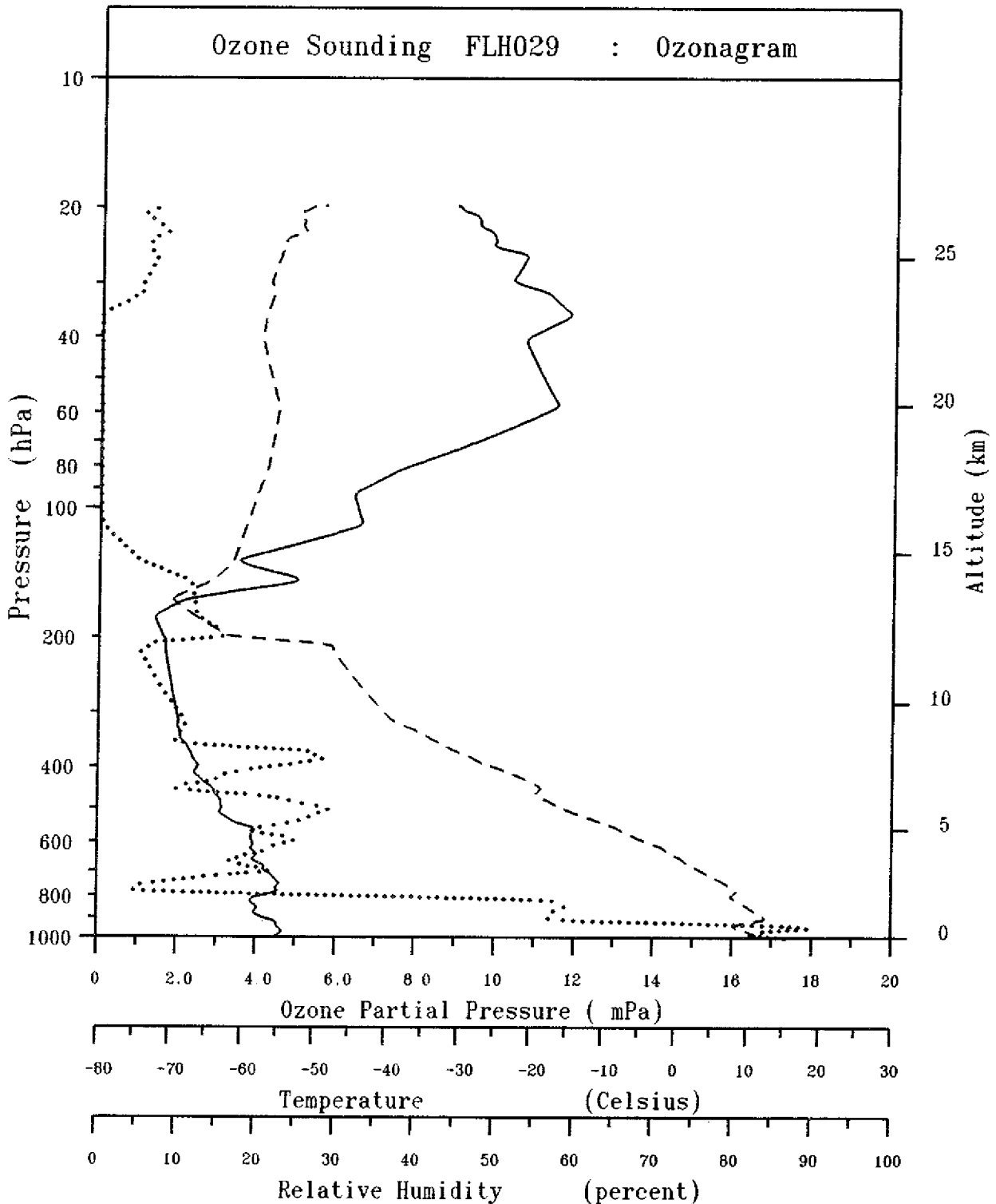


Date	13-04-1987	—	Ozone
Time at launch	20:47 (UTC)	- - -	Temperature
Location	44:36 N , 16:48 W	.....	Relative Humidity



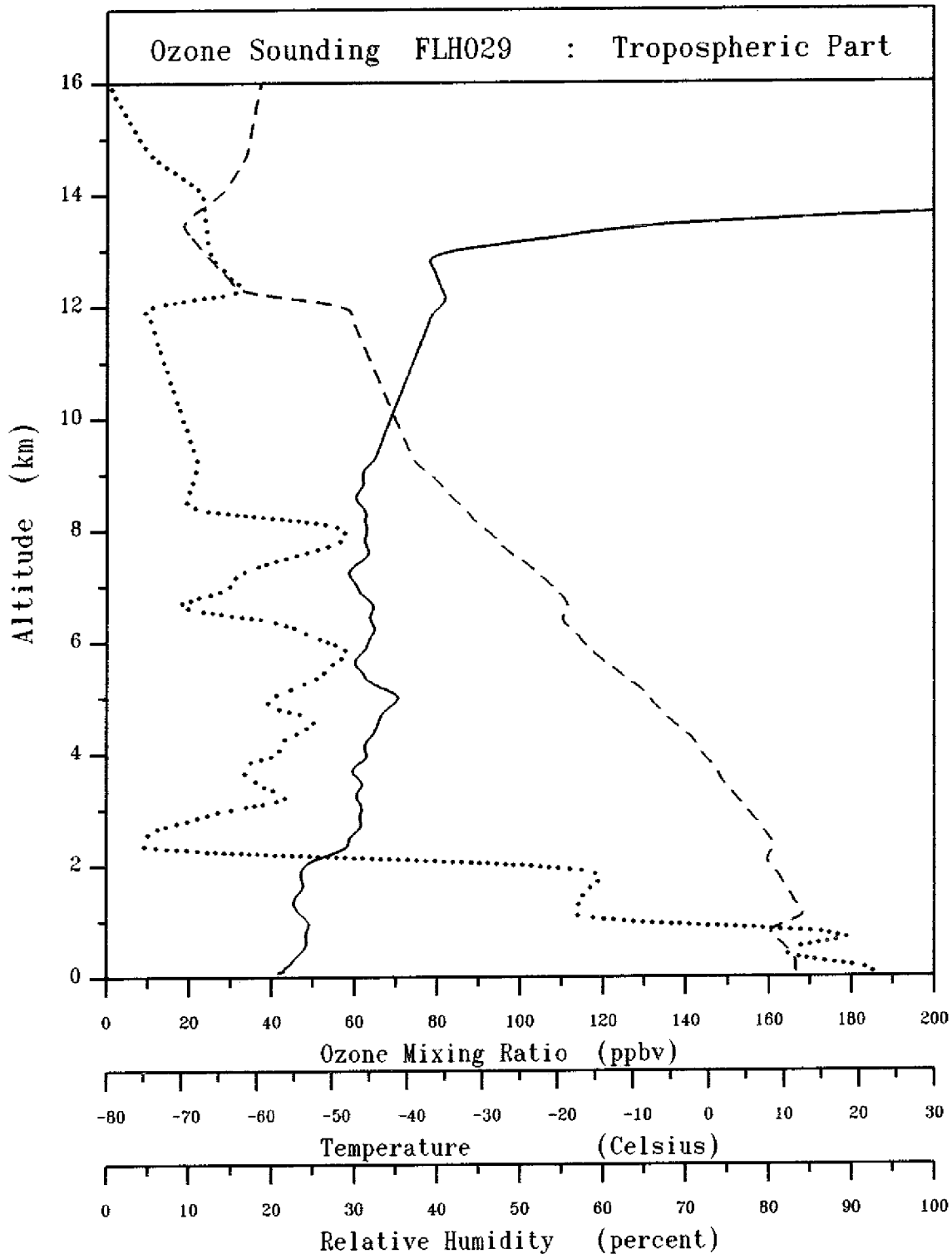
Date 13-04-1987
 Time at launch 20:47 (UTC)
 Location 44:36 N , 16:48 W

— Ozone
 - - - Temperature
 Relative Humidity

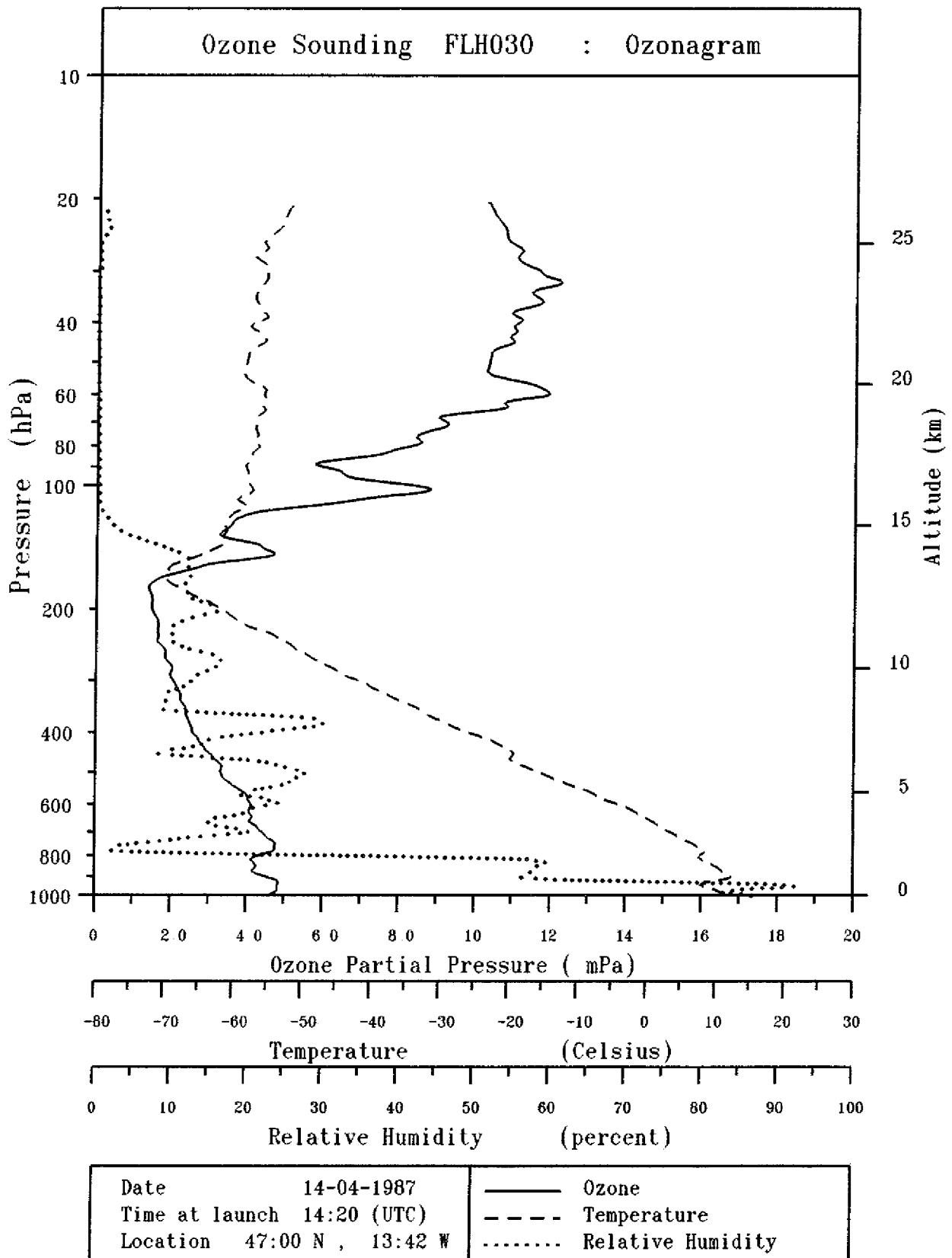


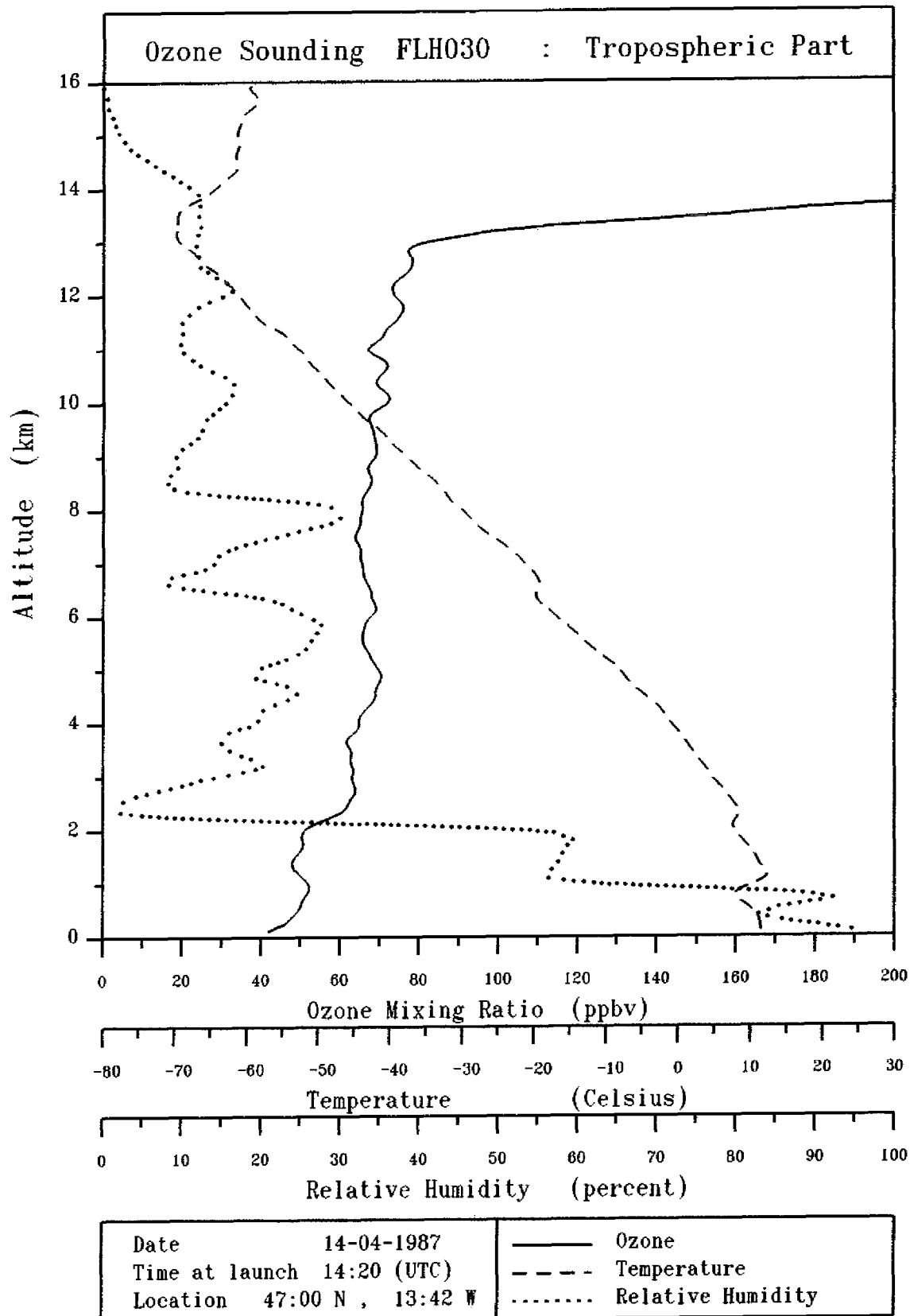
Date 14-04-1987
 Time at launch 14:20 (UTC)
 Location 47:00 N , 13:42 W

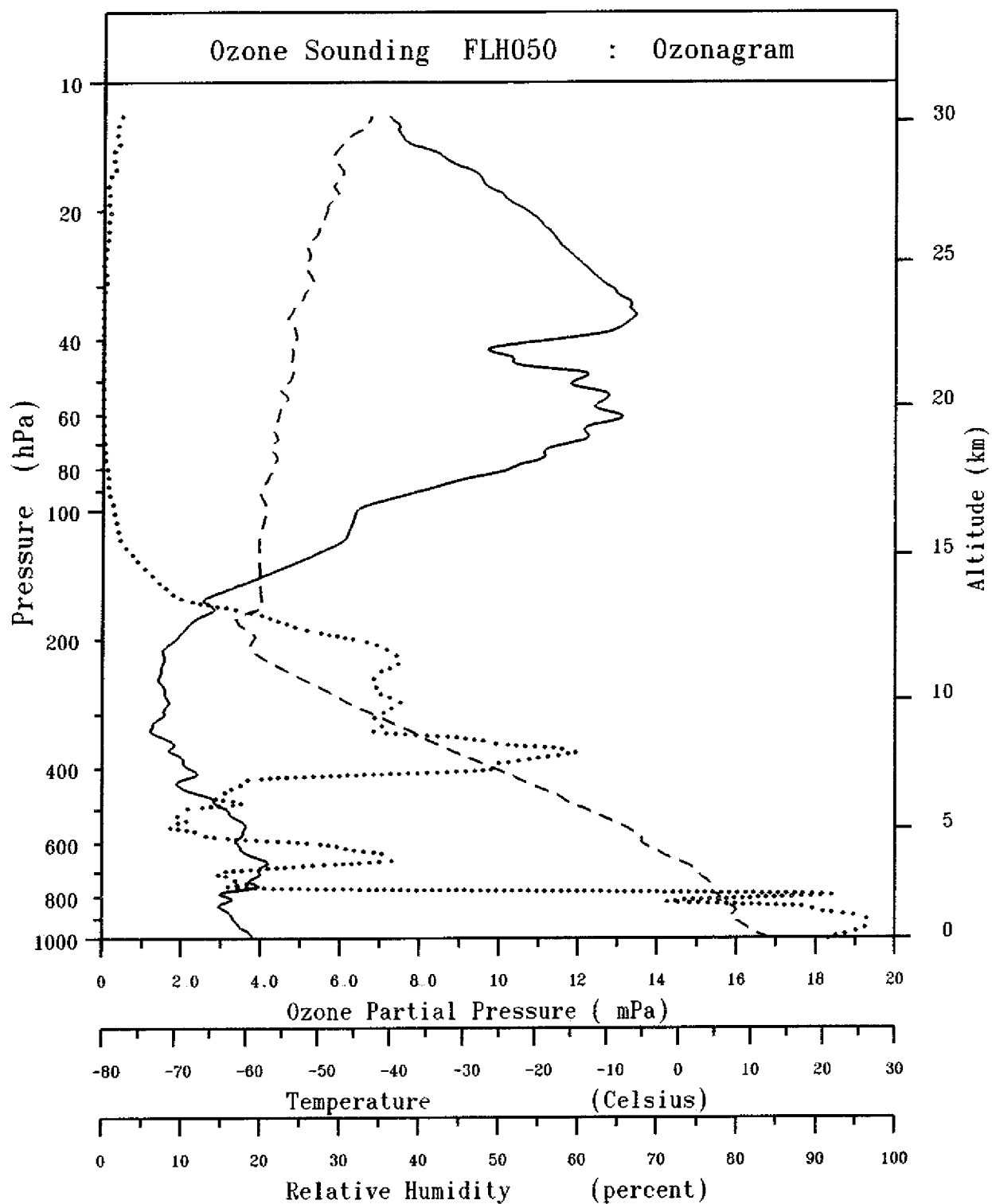
—— Ozone
 - - - - Temperature
 Relative Humidity



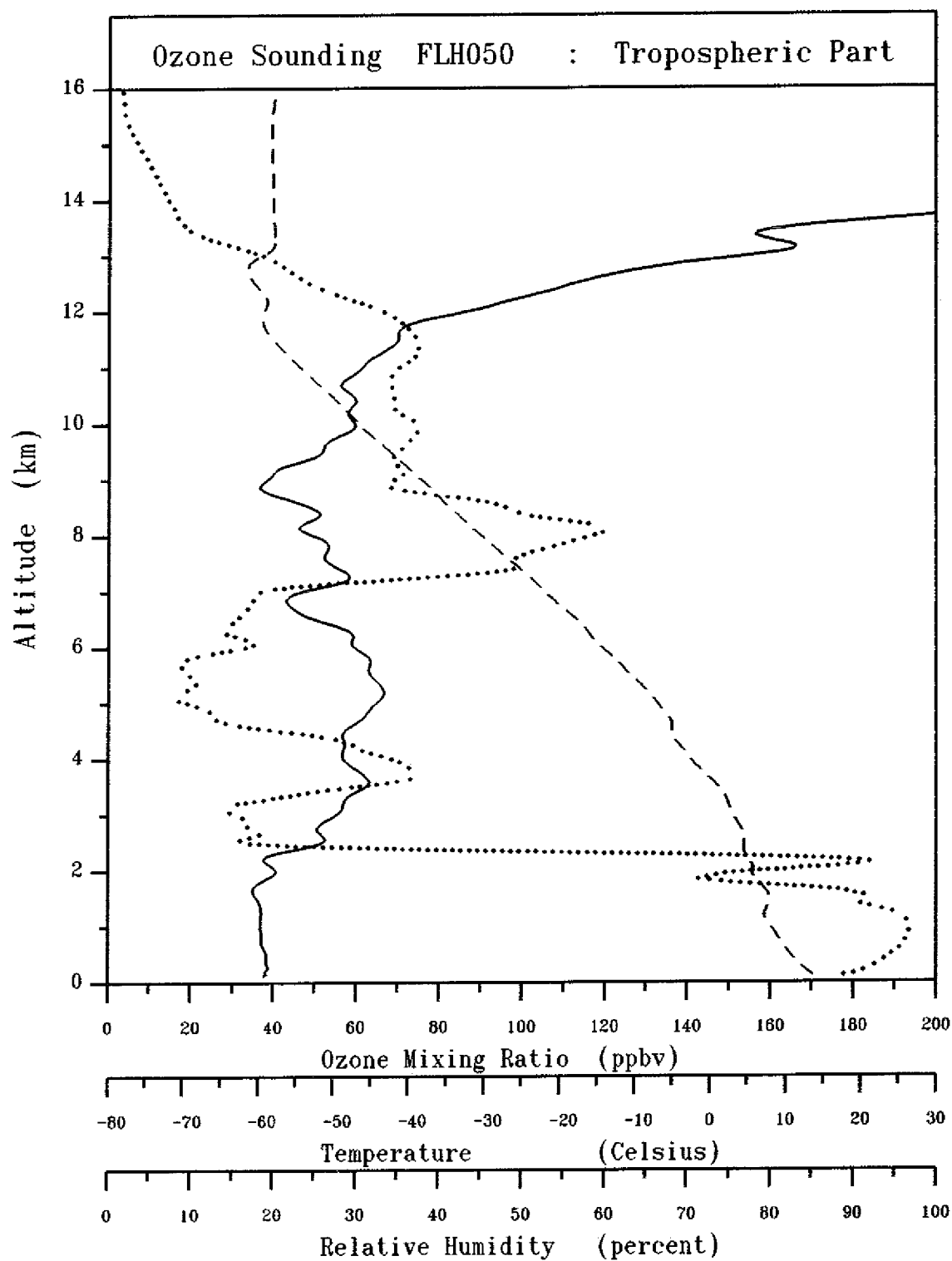
Date	14-04-1987	—	Ozone
Time at launch	14:20 (UTC)	- - - -	Temperature
Location	47:00 N , 13:42 W	.....	Relative Humidity





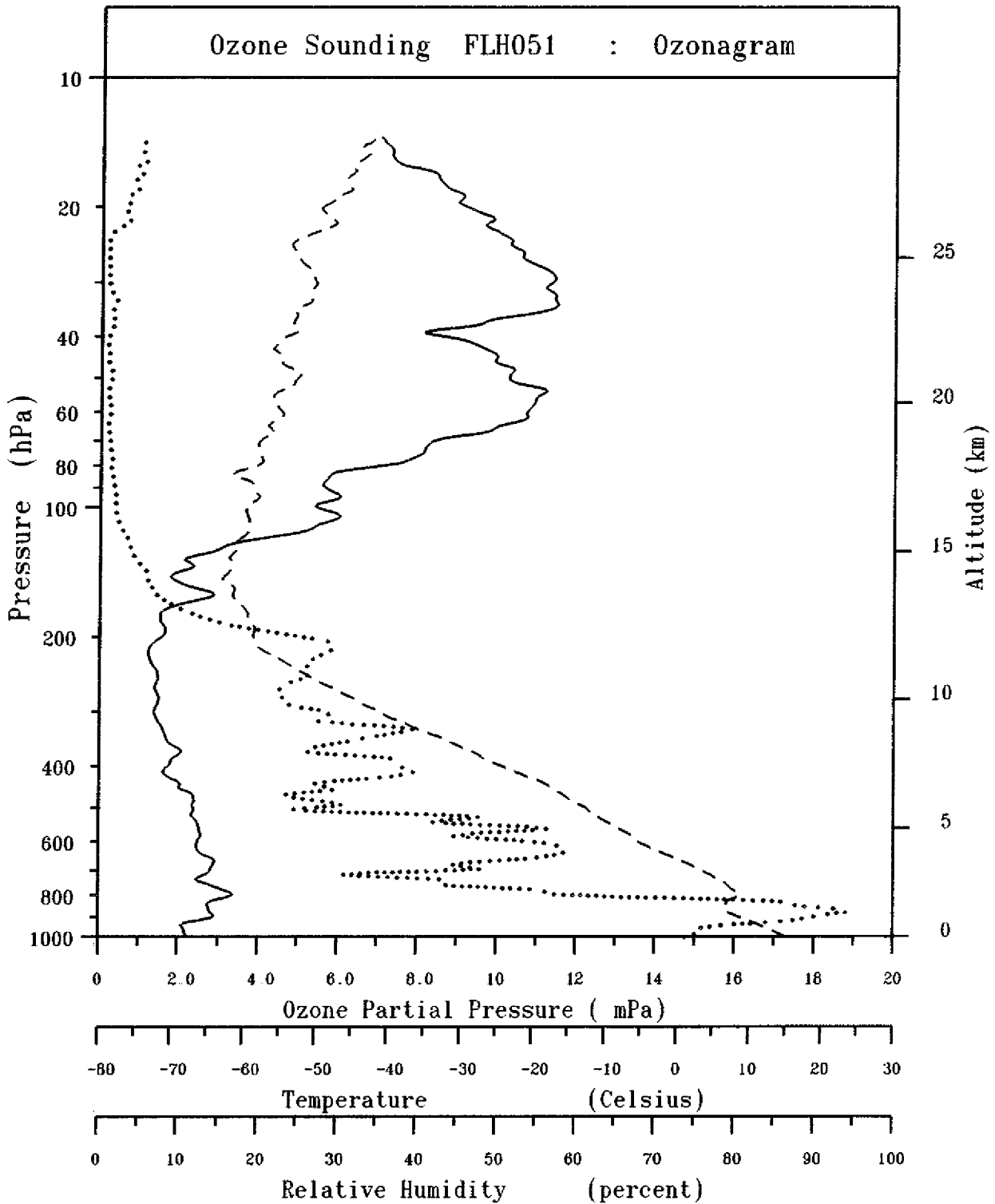


Date	16-09-1988	—	Ozone
Time at launch	19:40 (UTC)	- - - -	Temperature
Location	52:24 N , 3:24 E	.....	Relative Humidity

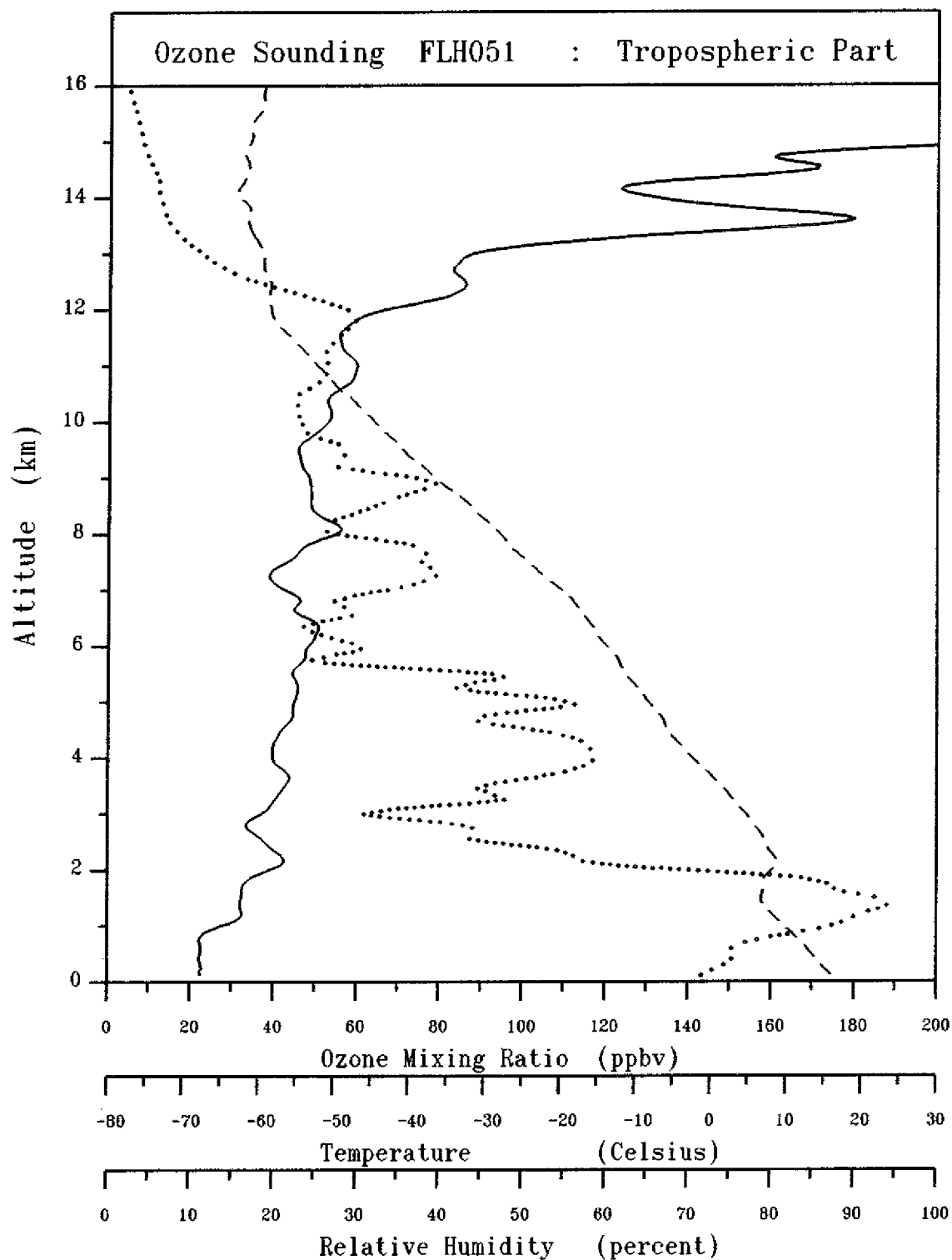


Date 16-09-1988
 Time at launch 19:40 (UTC)
 Location 52:24 N , 3:24 E

— Ozone
 --- Temperature
 Relative Humidity



Date	17-09-1988	—	Ozone
Time at launch	14:55 (UTC)	- - - -	Temperature
Location	50:06 N , 2:12 W	.....	Relative Humidity



Date 17-09-1988

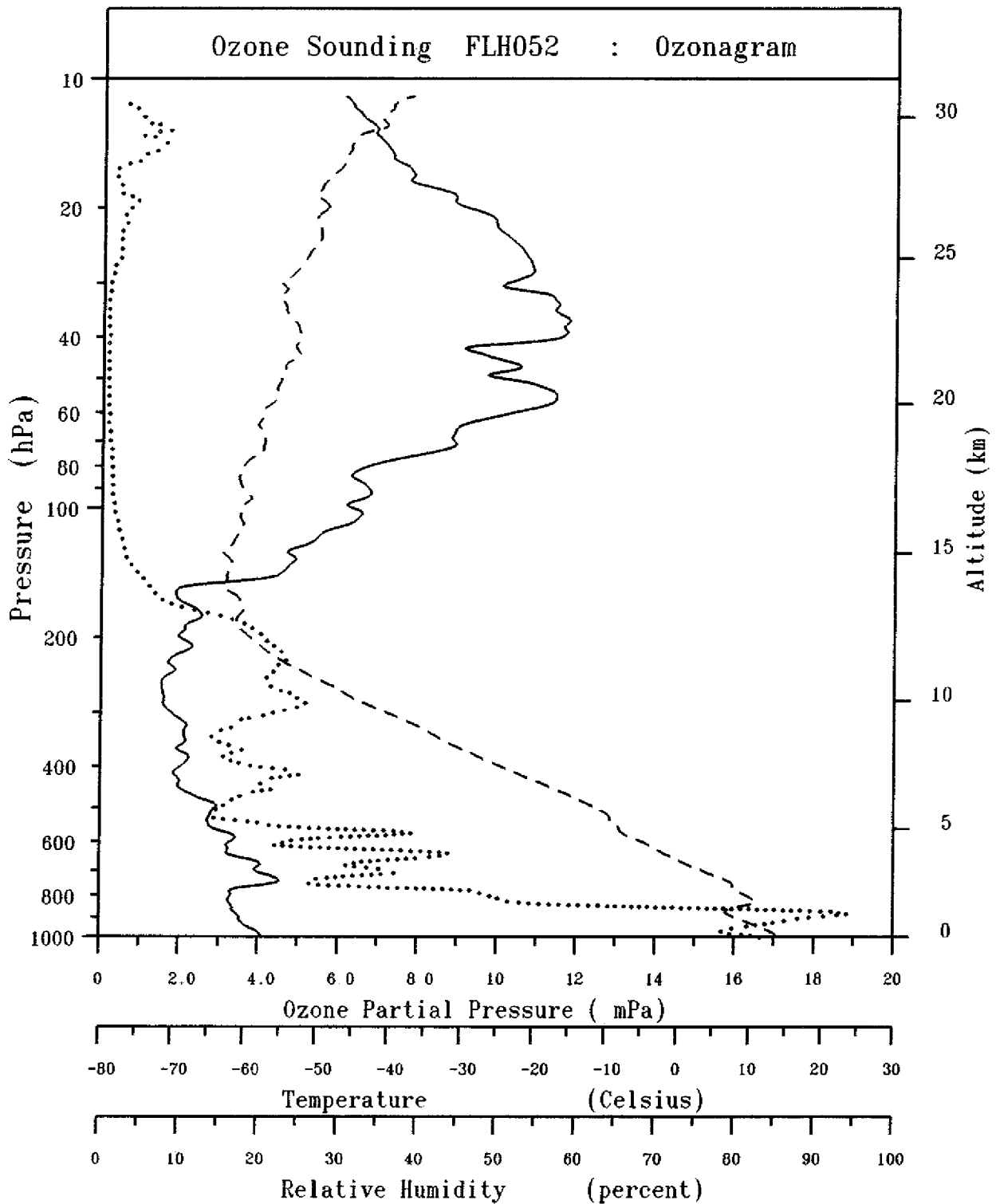
Time at launch 14:55 (UTC)

Location 50:06 N , 2:12 W

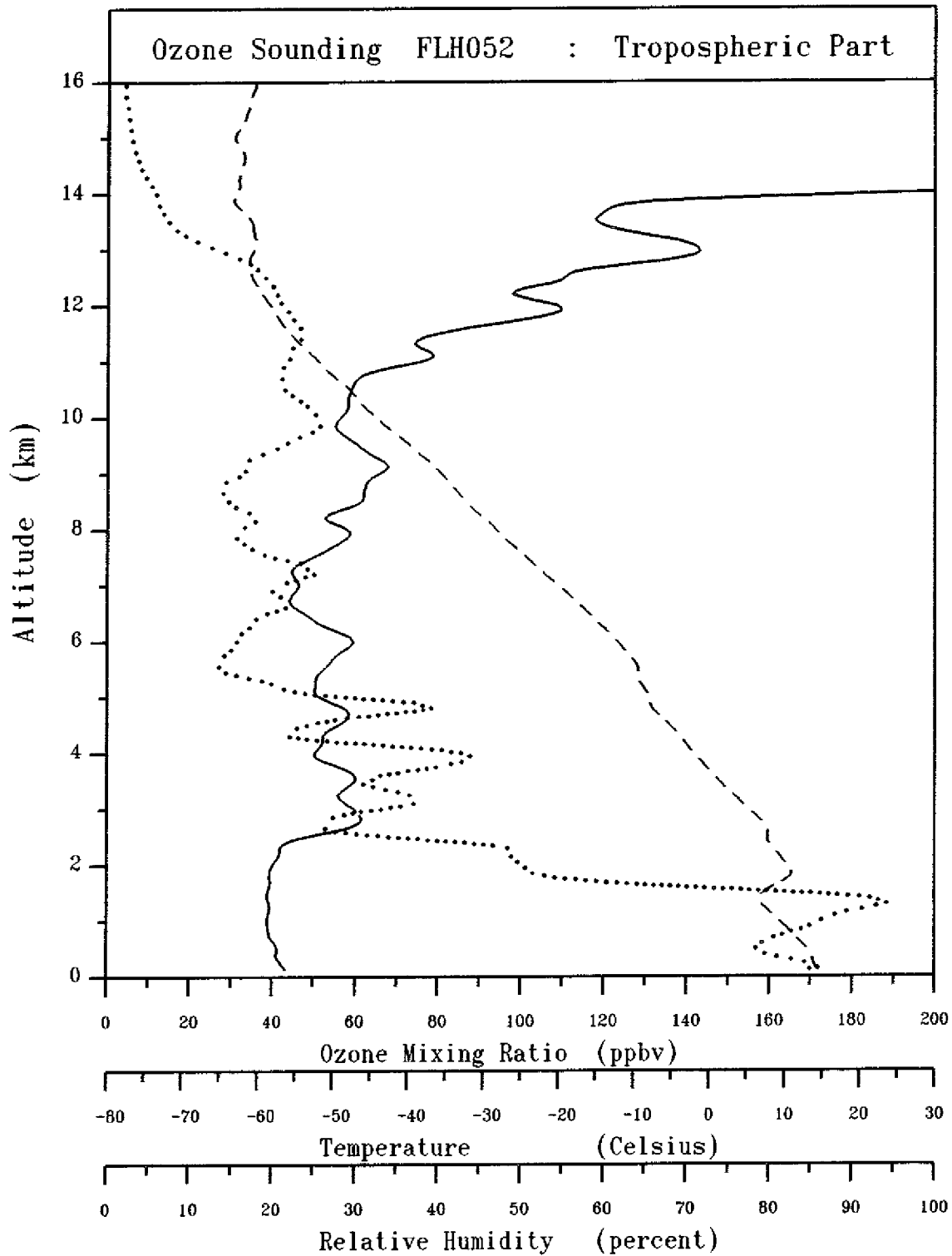
— Ozone

- - - Temperature

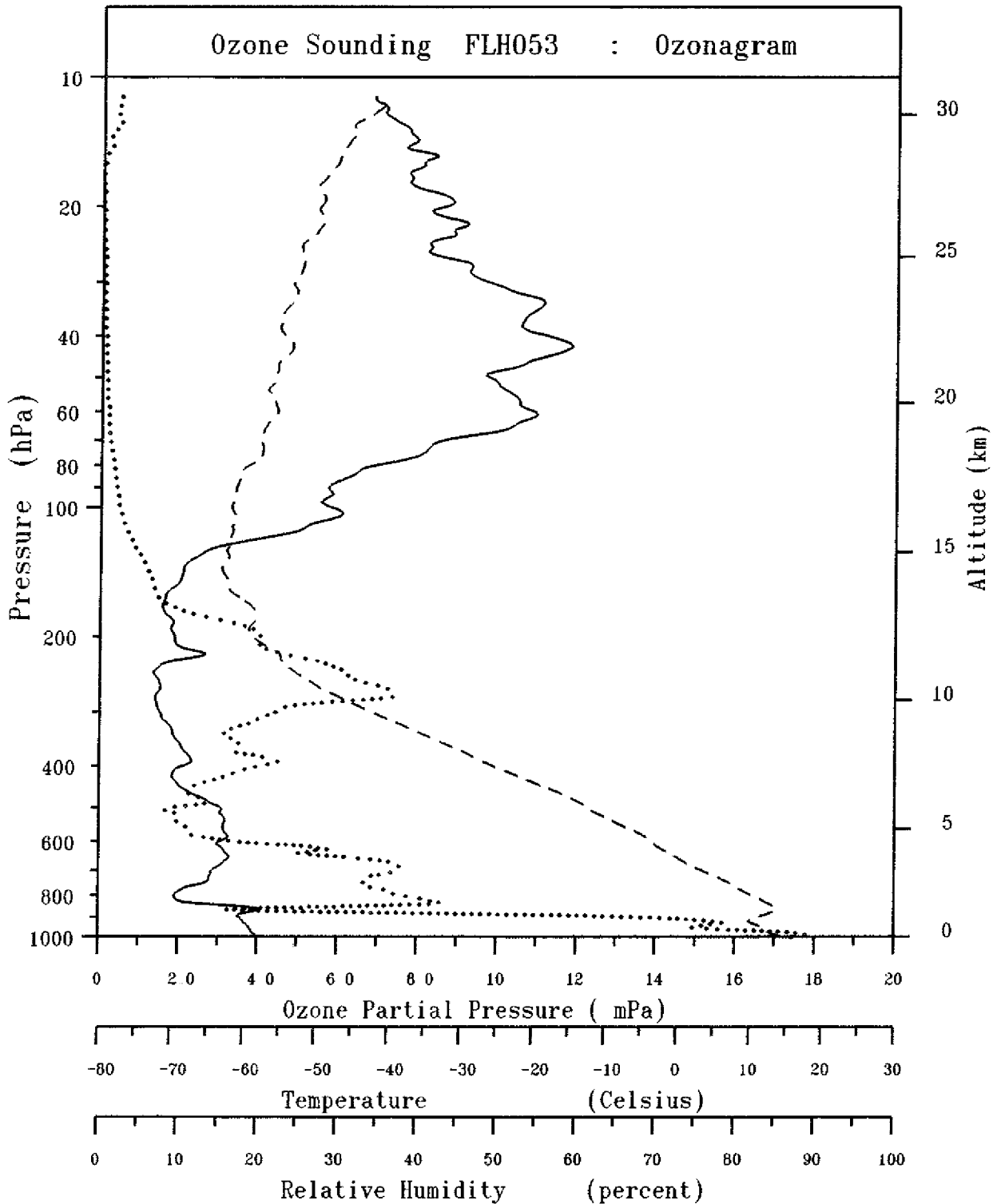
..... Relative Humidity



Date	18-09-1988	—	Ozone
Time at launch	10:05 (UTC)	- - - -	Temperature
Location	47:27 N , 7:36 W	.....	Relative Humidity

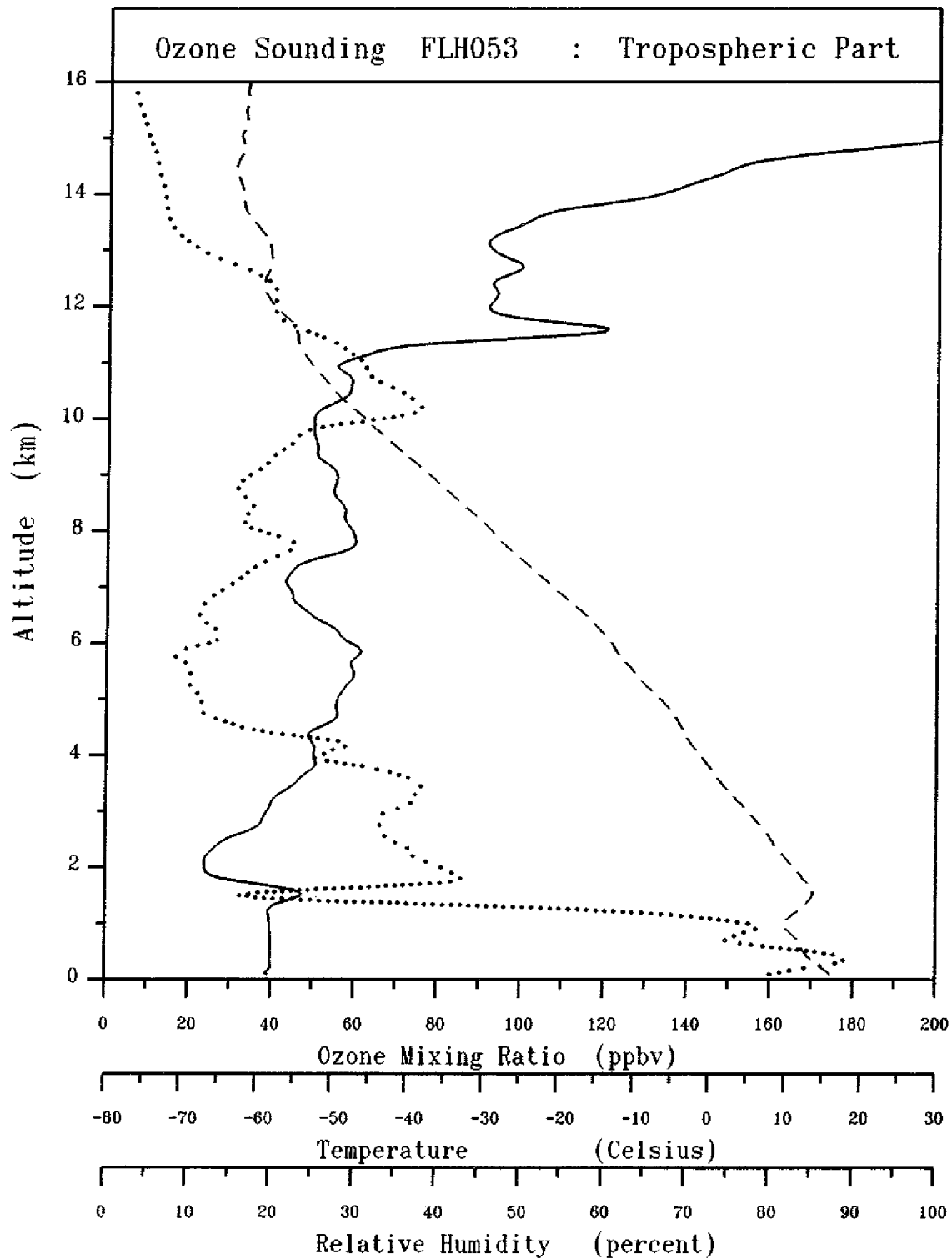


Date	18-09-1988	—	Ozone
Time at launch	10:05 (UTC)	- - -	Temperature
Location	47:27 N , 7:36 W	.....	Relative Humidity



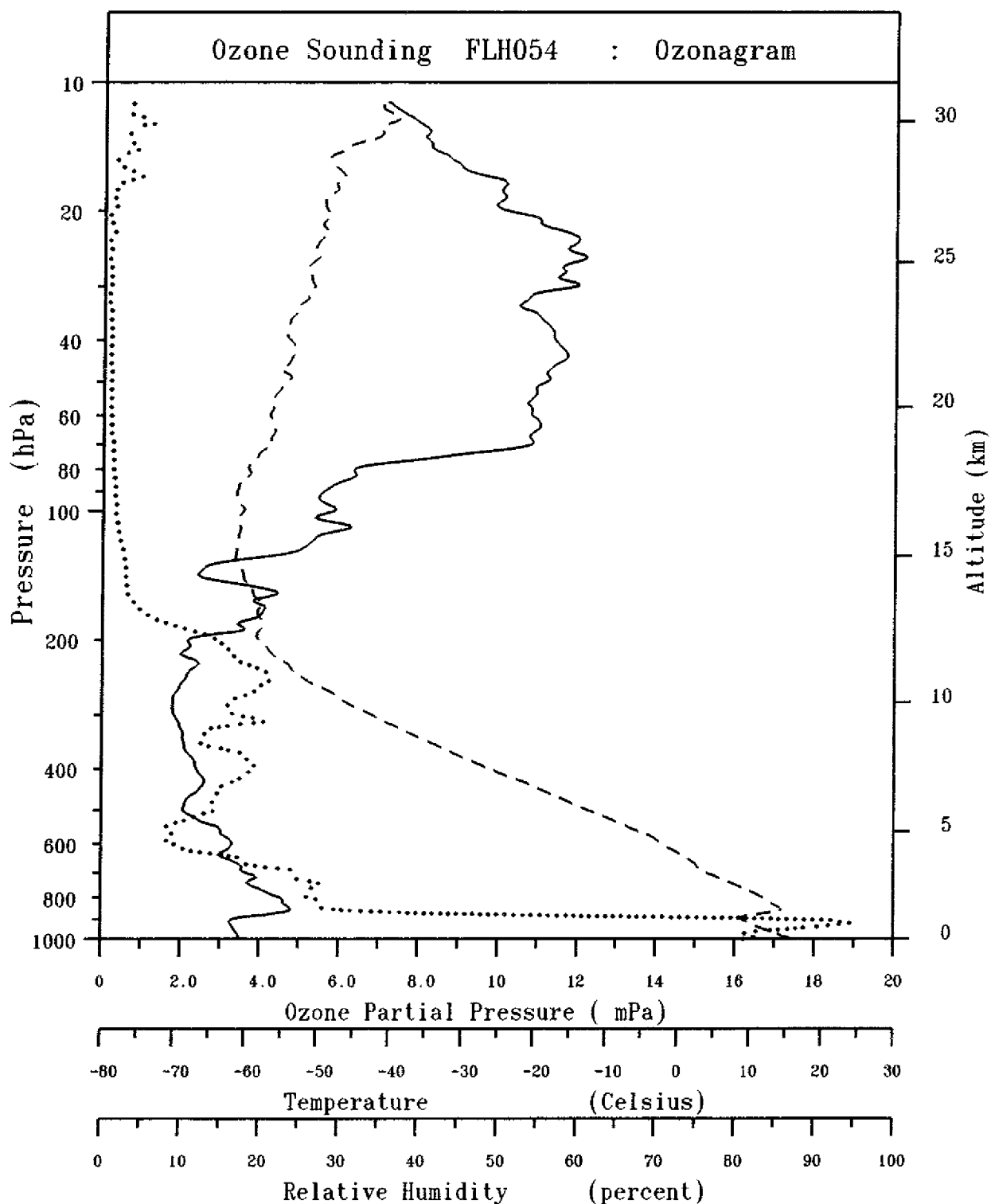
Date 18-09-1988
 Time at launch 22:00 (UTC)
 Location 45:48 N , 10:30 W

— Ozone
 --- Temperature
 Relative Humidity



Date 18-09-1988
 Time at launch 22:00 (UTC)
 Location 45:48 N , 10:30 W

— Ozone
 --- Temperature
 Relative Humidity



Date 19-09-1988

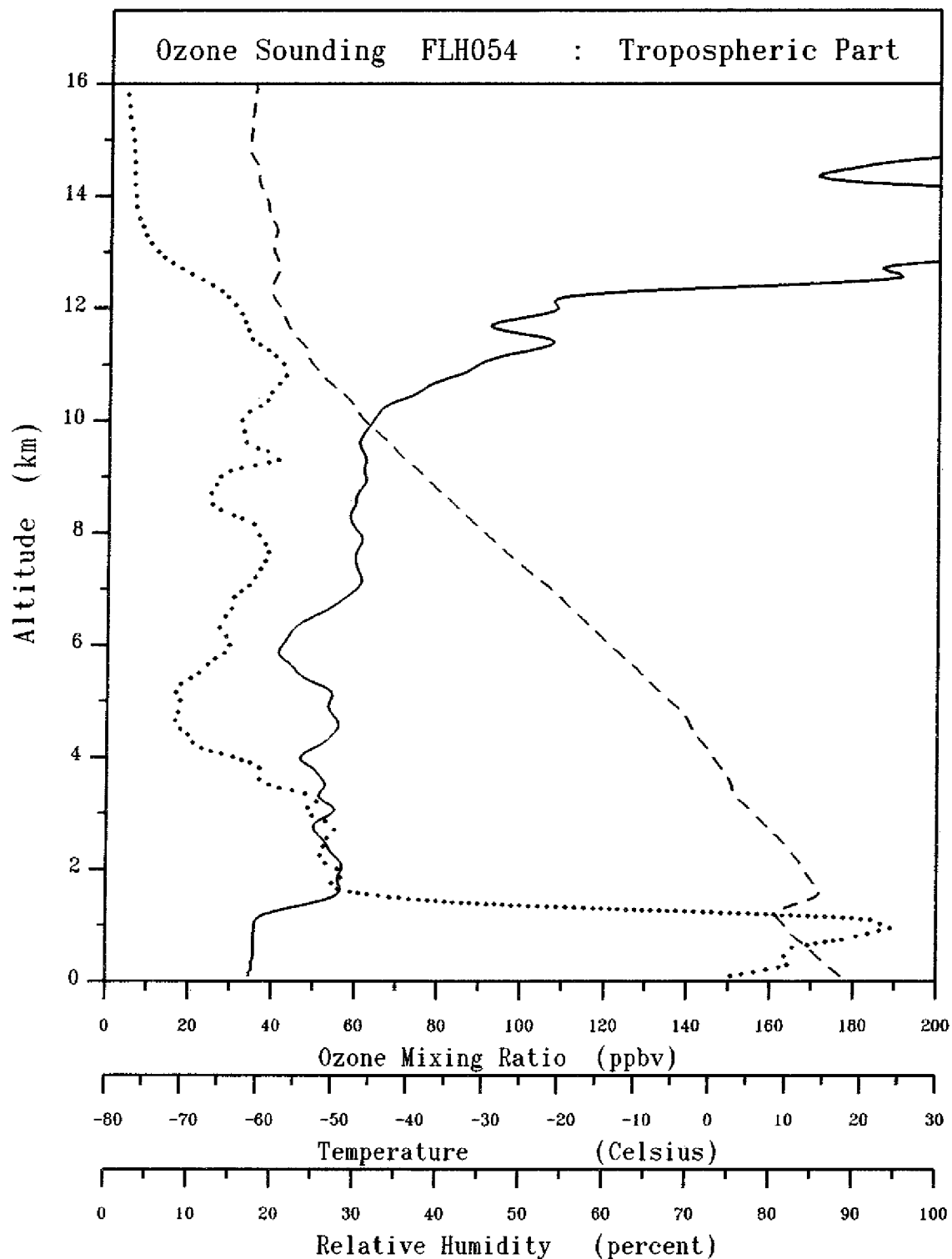
Time at launch 10:00 (UTC)

Location 44:06 N , 13:33 W

— Ozone

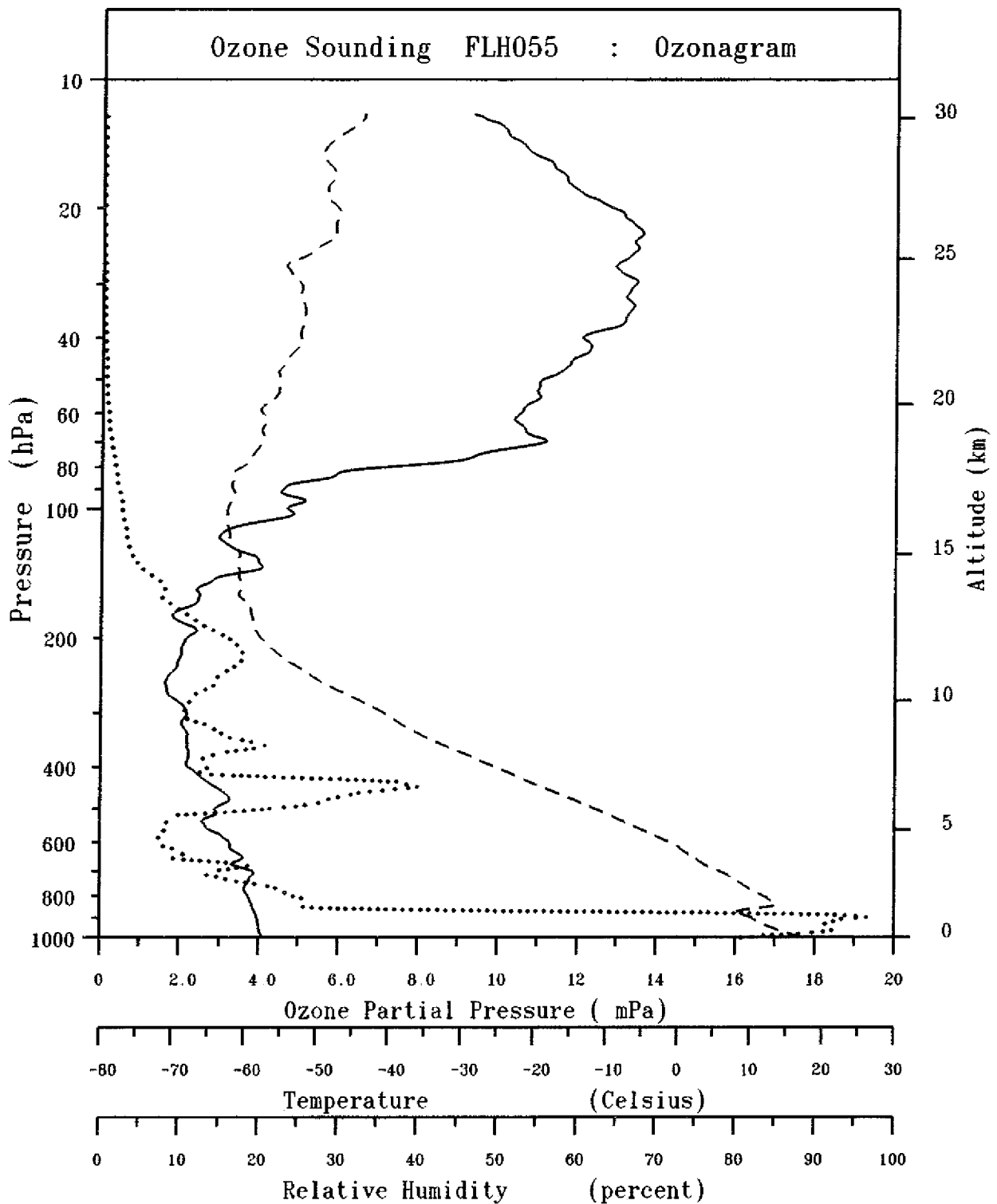
- - - Temperature

..... Relative Humidity



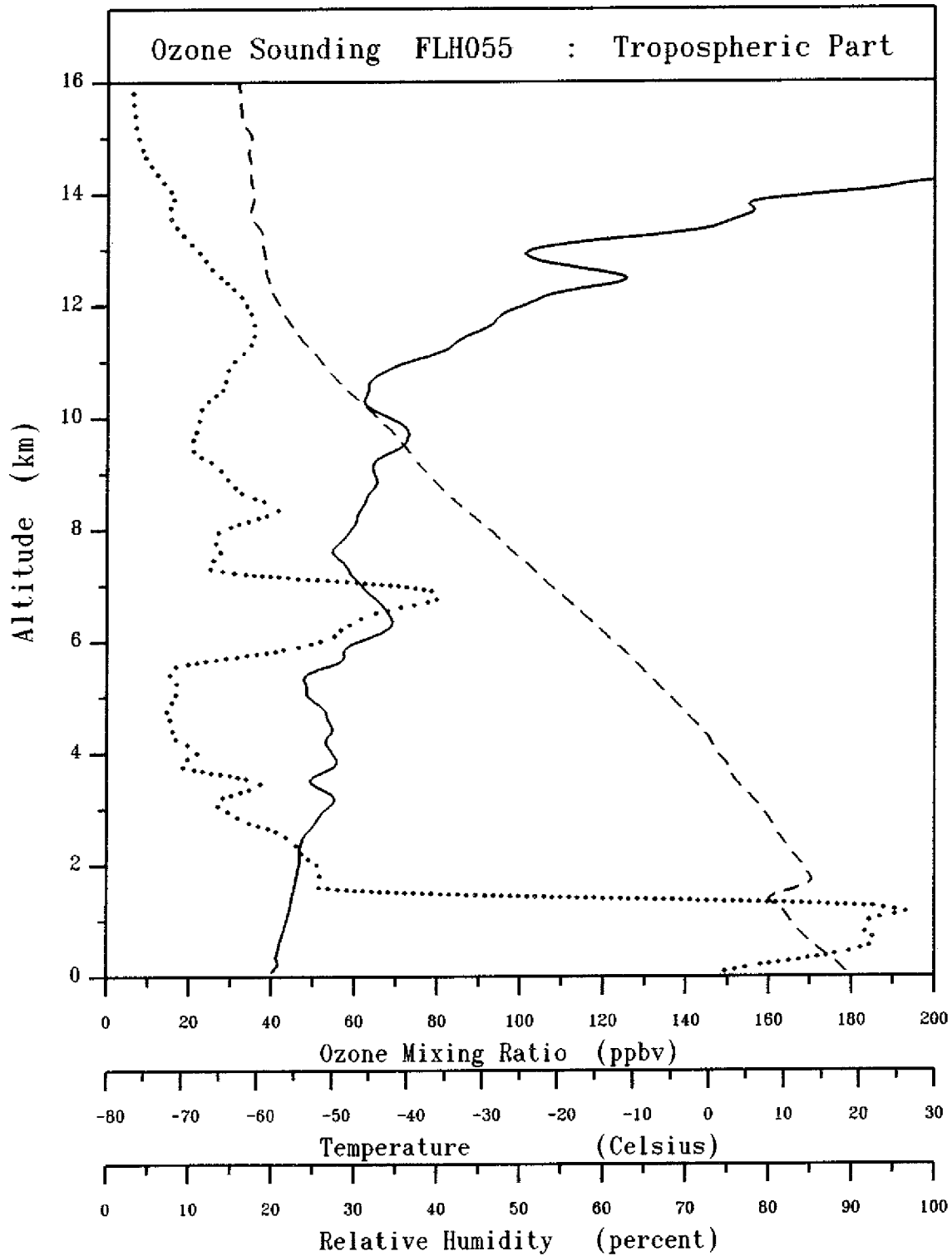
Date 19-09-1988
 Time at launch 10:00 (UTC)
 Location 44:06 N , 13:33 W

— Ozone
 - - - Temperature
 Relative Humidity



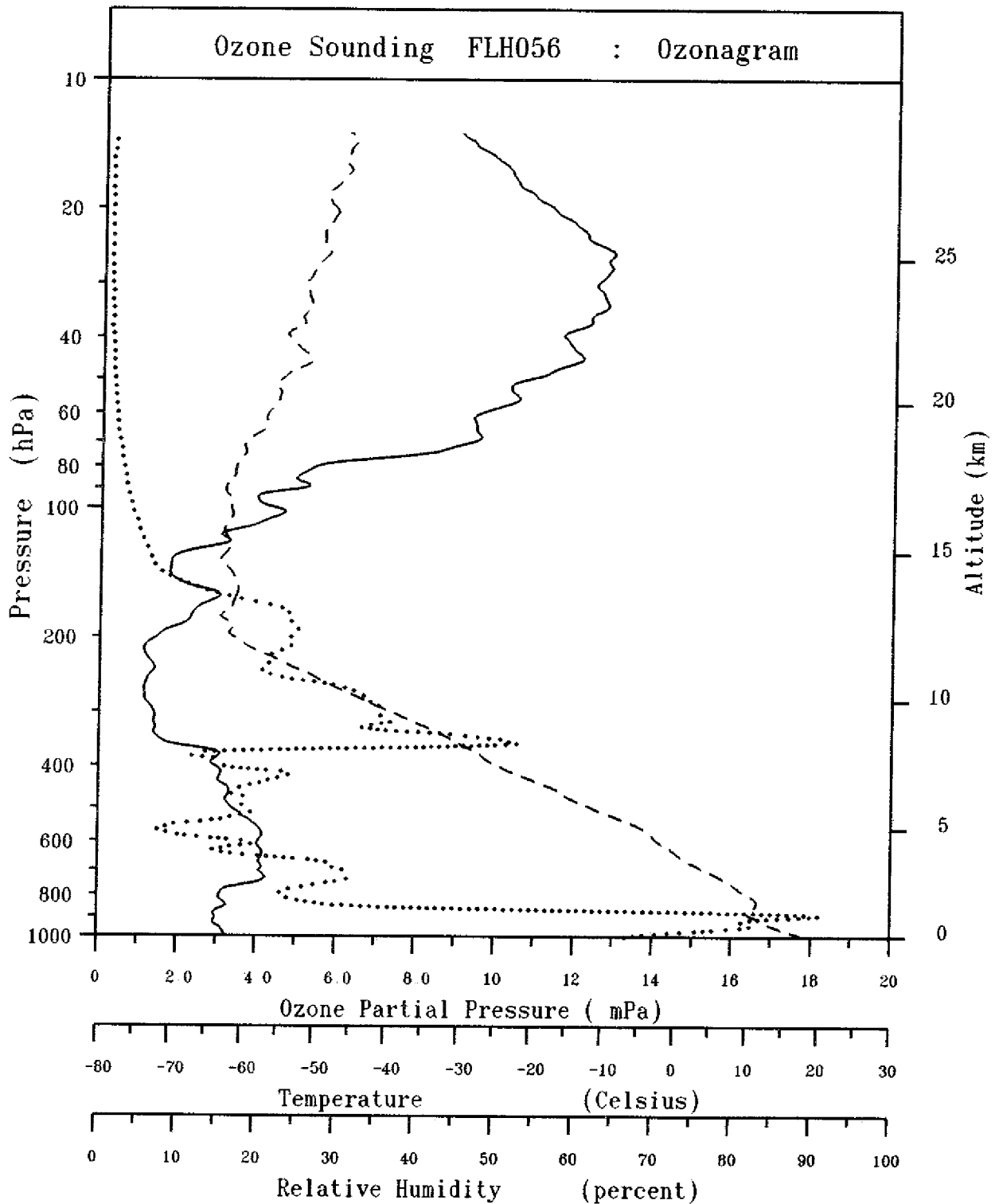
Date 19-09-1988
 Time at launch 21:45 (UTC)
 Location 42:24 N , 16:18 W

— Ozone
 - - - Temperature
 Relative Humidity

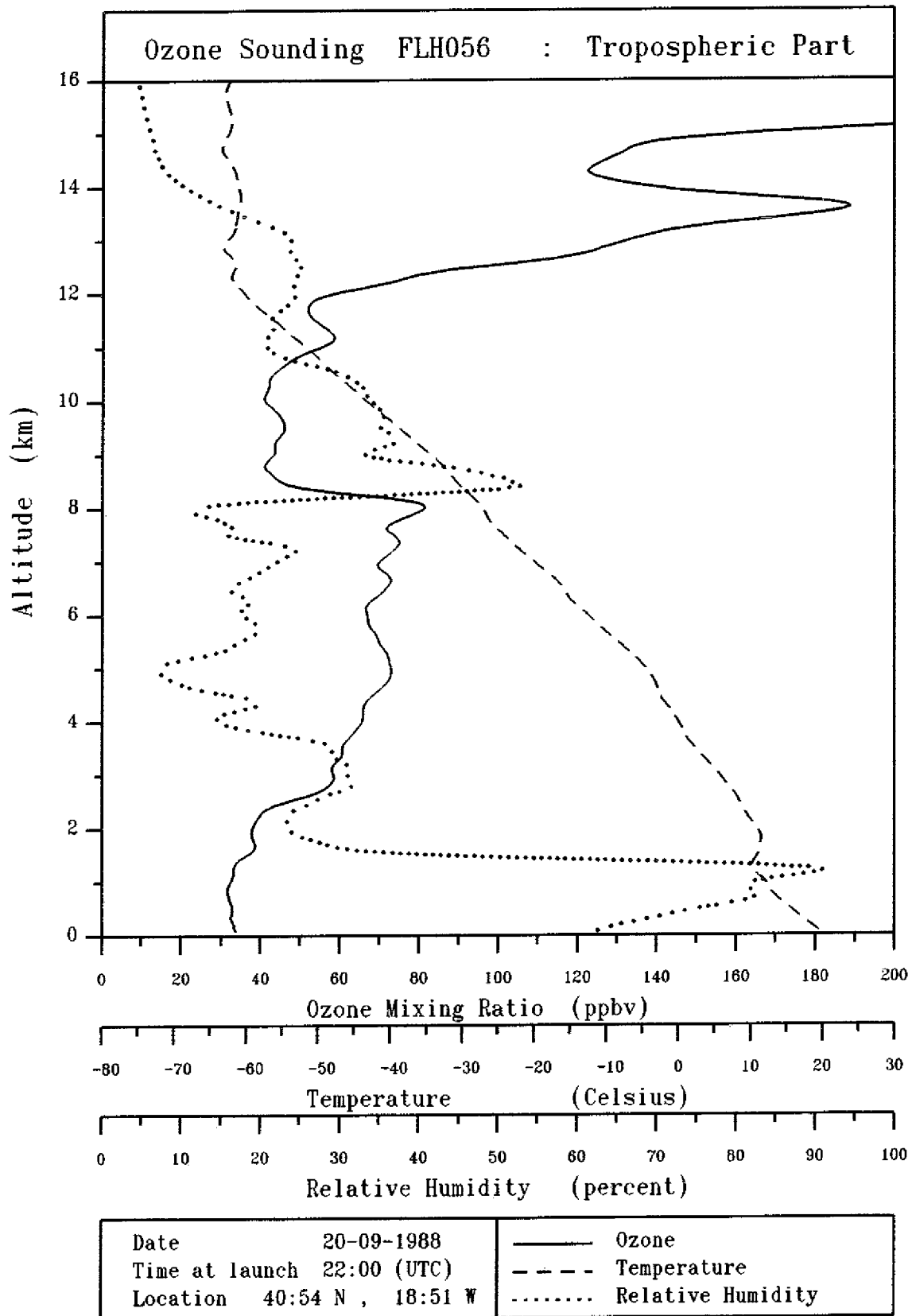


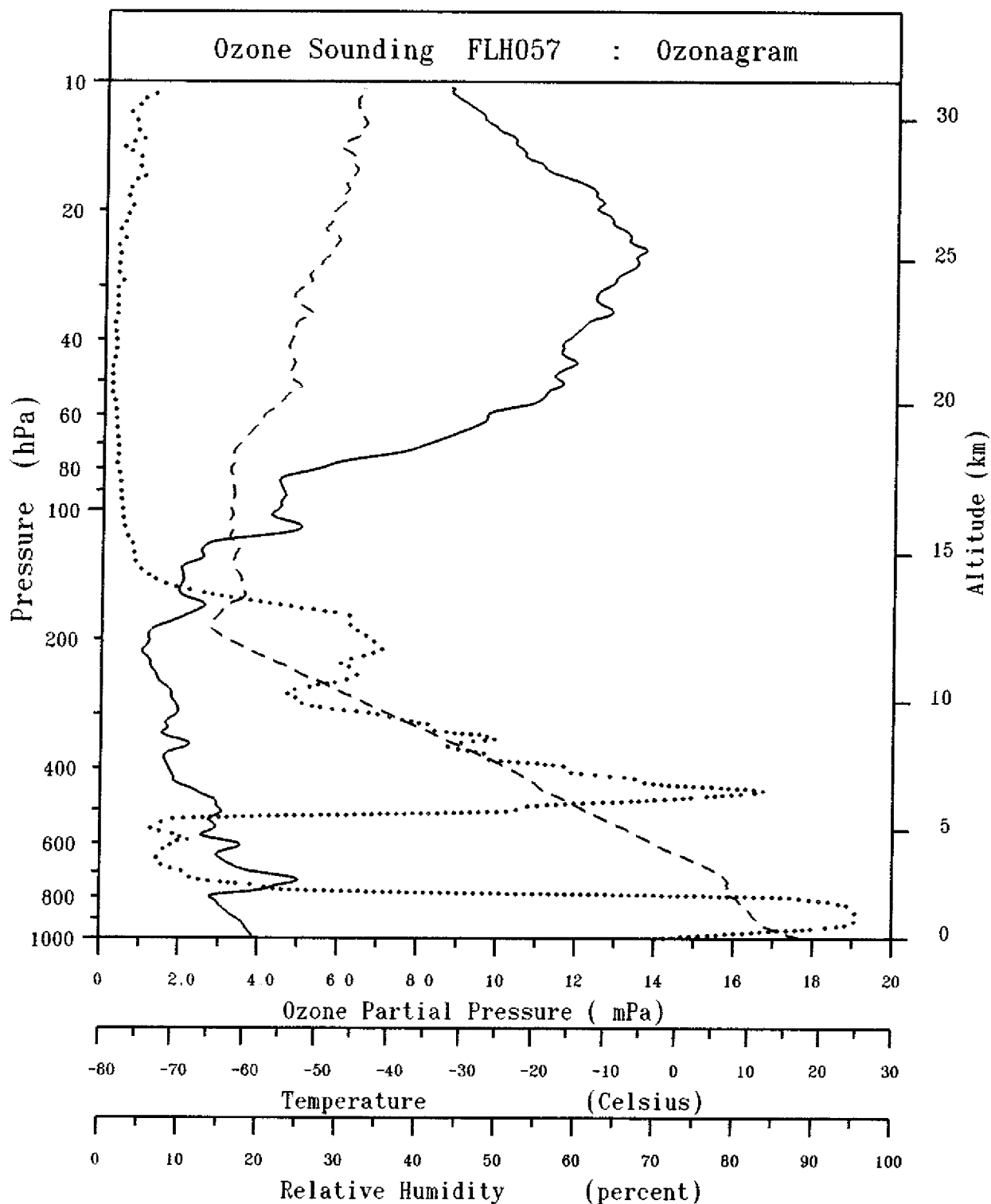
Date 19-09-1988
 Time at launch 21:45 (UTC)
 Location 42:24 N , 16:18 W

— Ozone
 - - - Temperature
 Relative Humidity



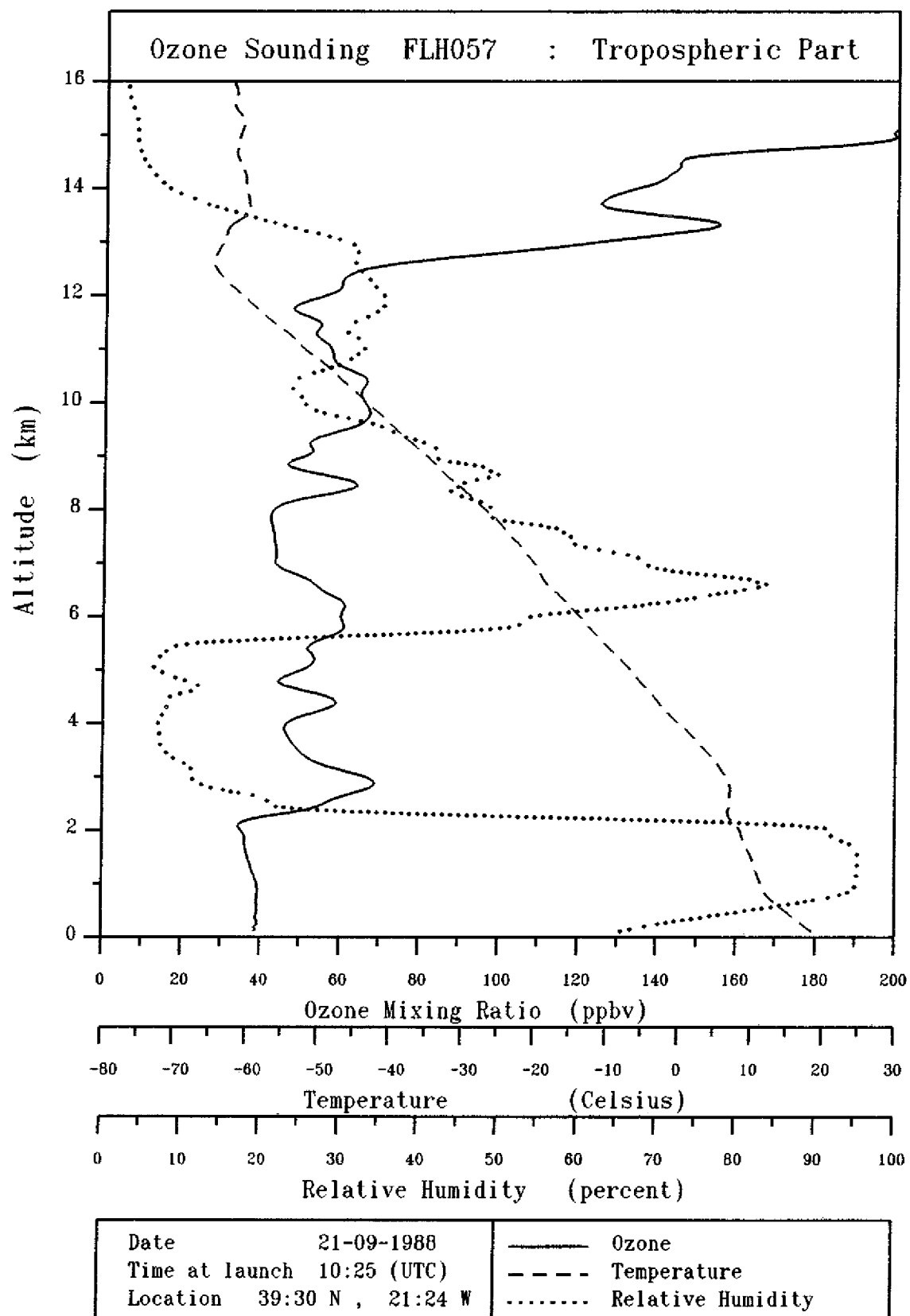
Date	20-09-1988	—	Ozone
Time at launch	22:00 (UTC)	- - -	Temperature
Location	40:54 N , 18:51 W	.....	Relative Humidity

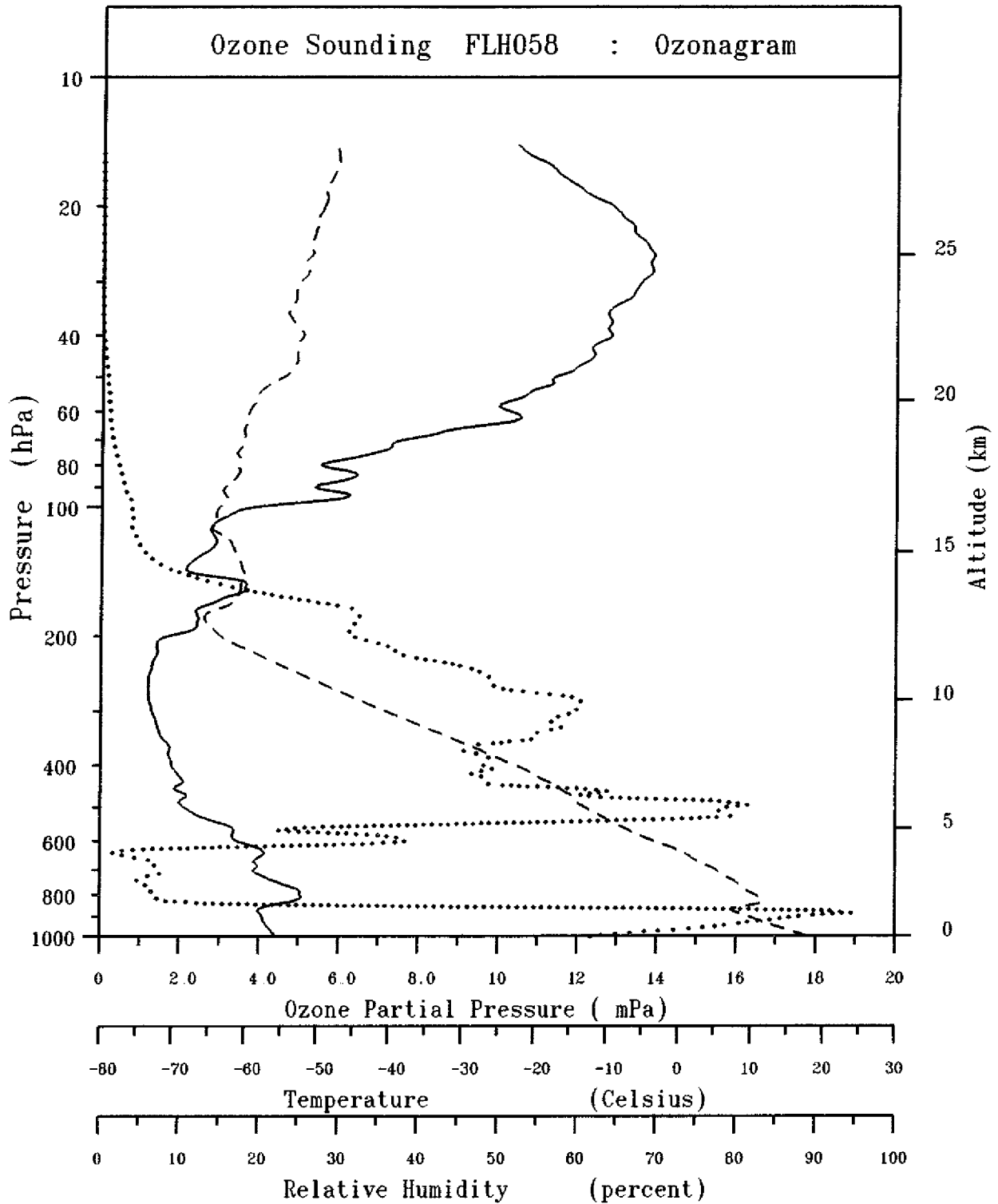




Date 21-09-1988
 Time at launch 10:25 (UTC)
 Location 39:30 N , 21:24 W

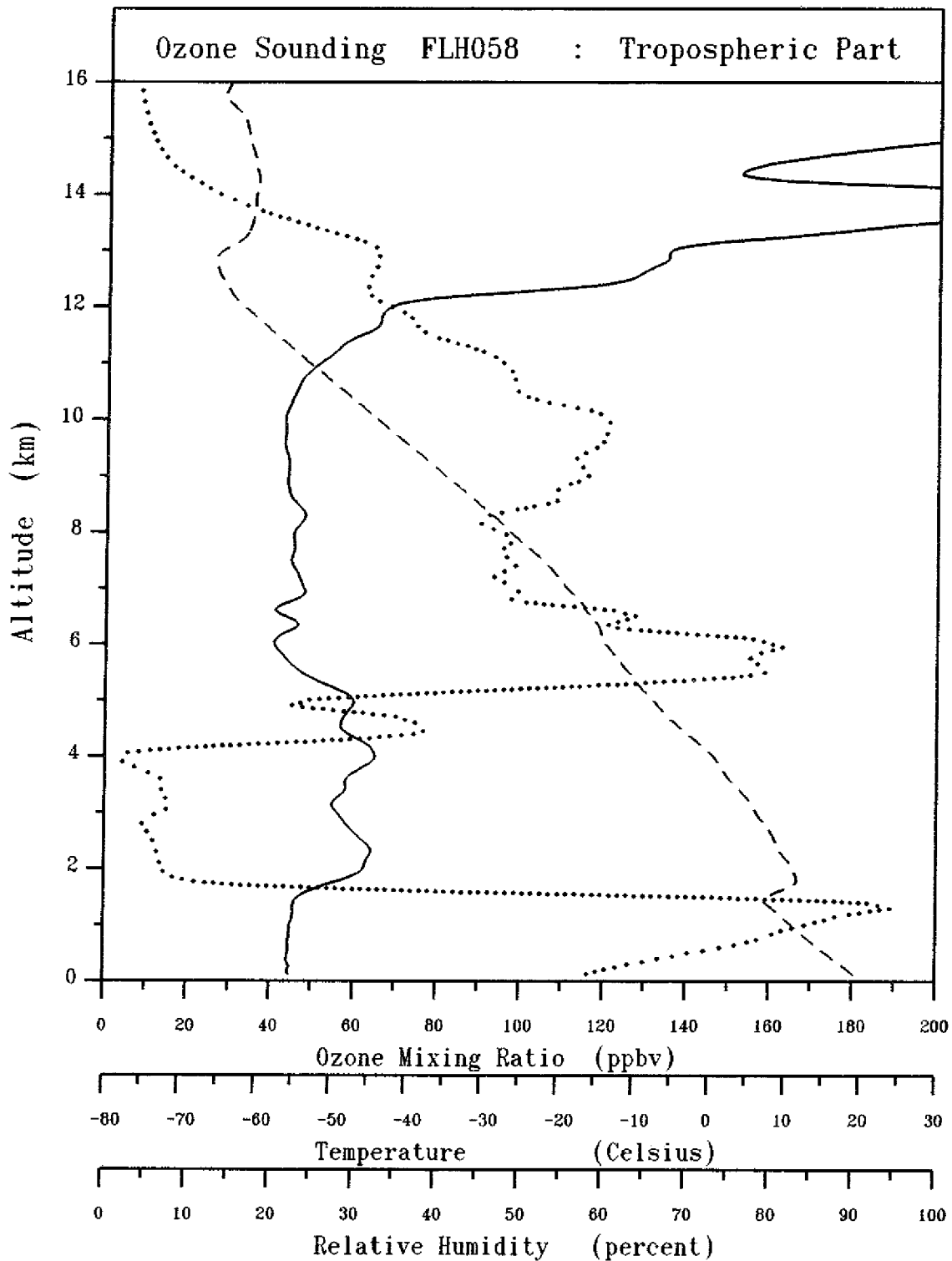
— Ozone
 --- Temperature
 Relative Humidity



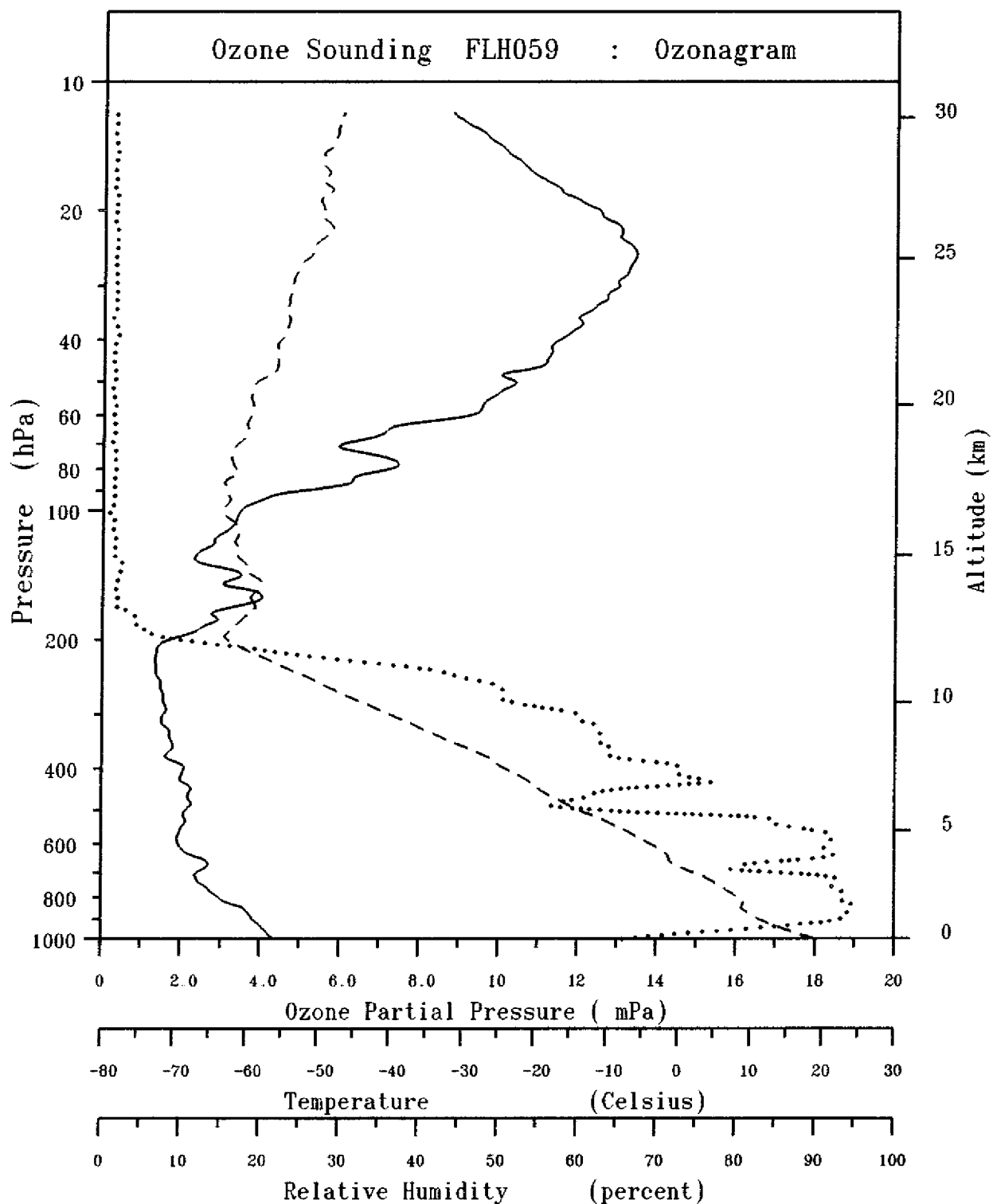


Date 21-09-1988
 Time at launch 21:45 (UTC)
 Location 38:18 N , 23:48 W

— Ozone
 --- Temperature
 Relative Humidity

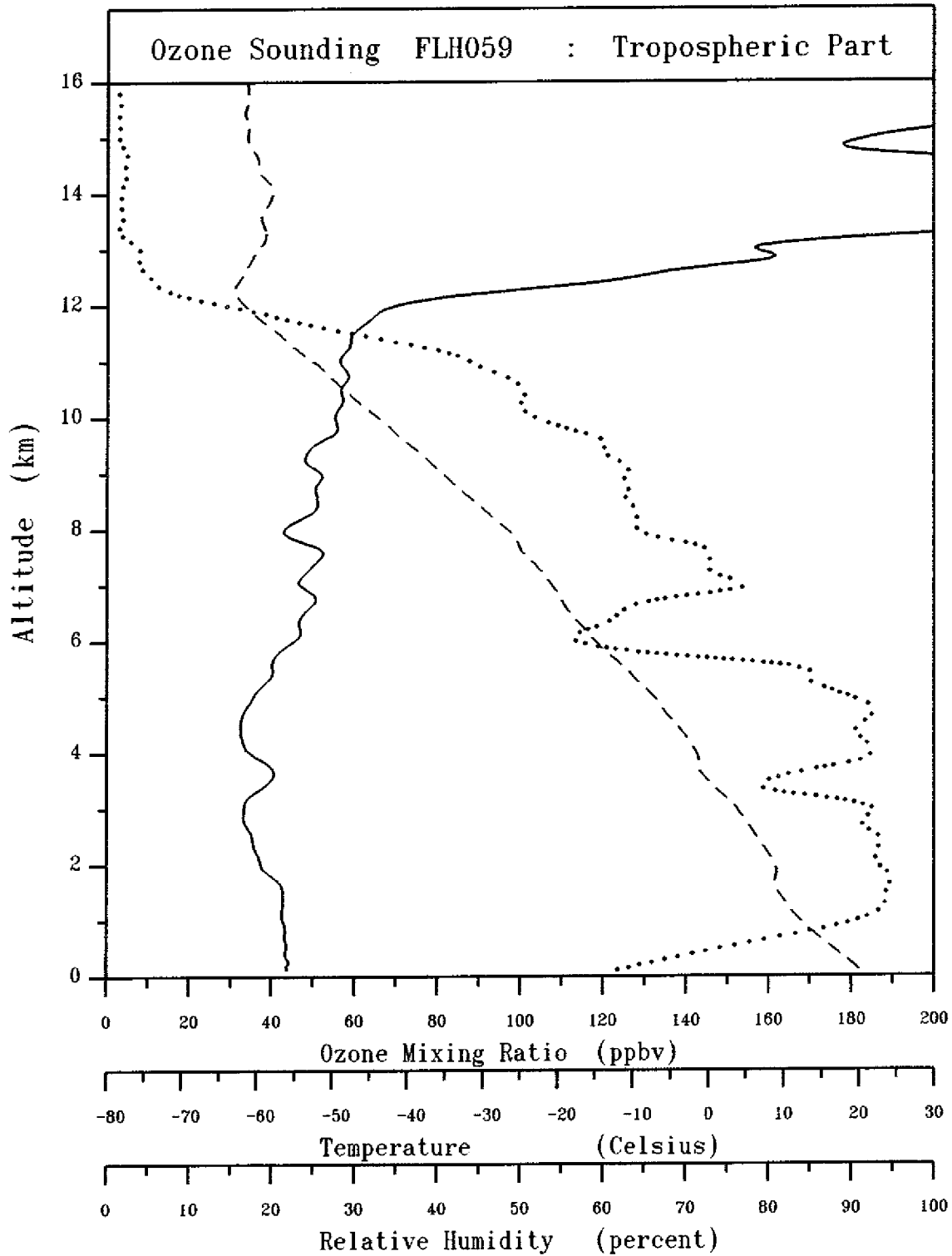


Date	21-09-1988	—	Ozone
Time at launch	21:45 (UTC)	- - - -	Temperature
Location	38:18 N , 23:48 W	.....	Relative Humidity

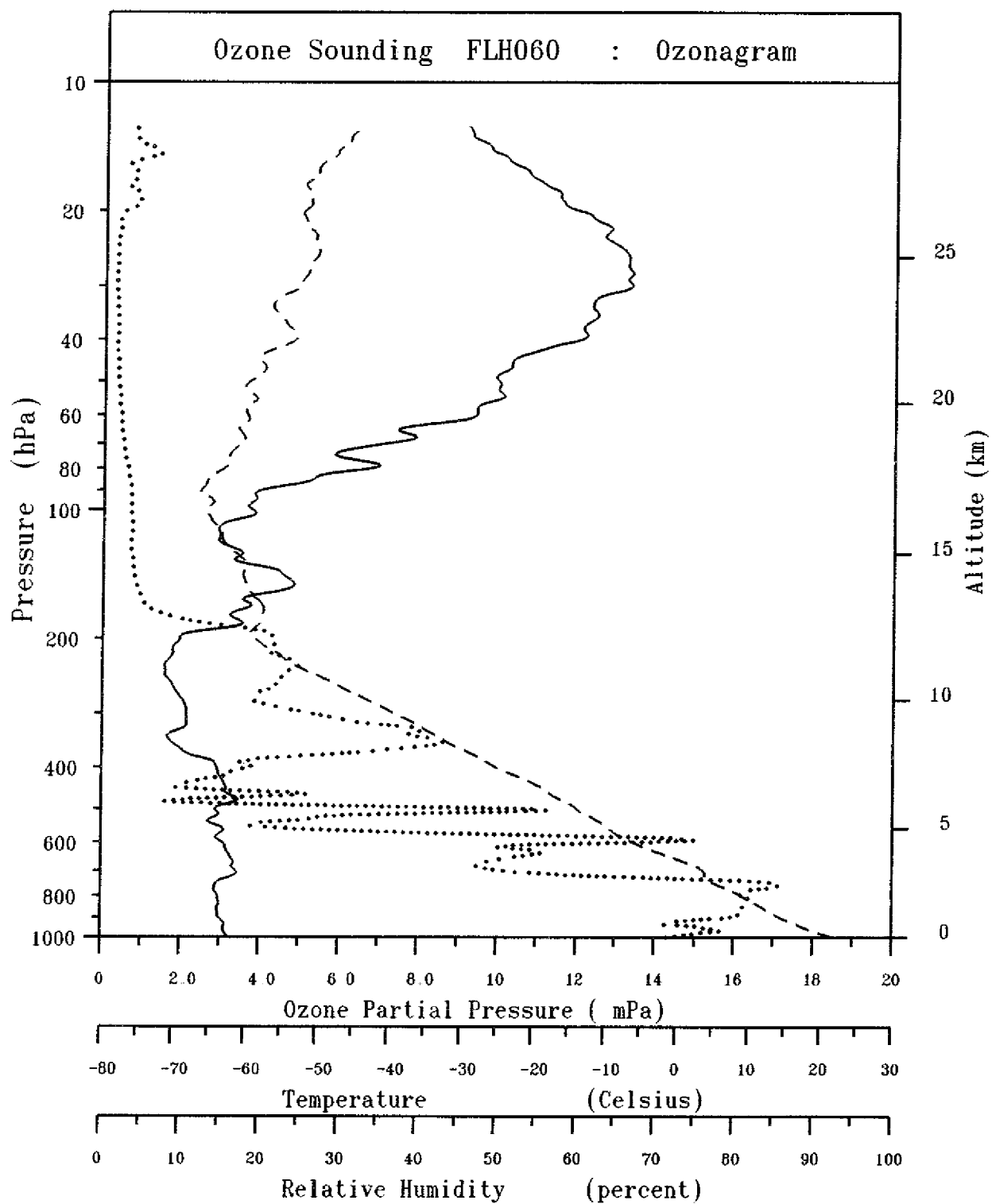


Date 22-09-1988
 Time at launch 14:20 (UTC)
 Location 37:07 N , 26:00 W

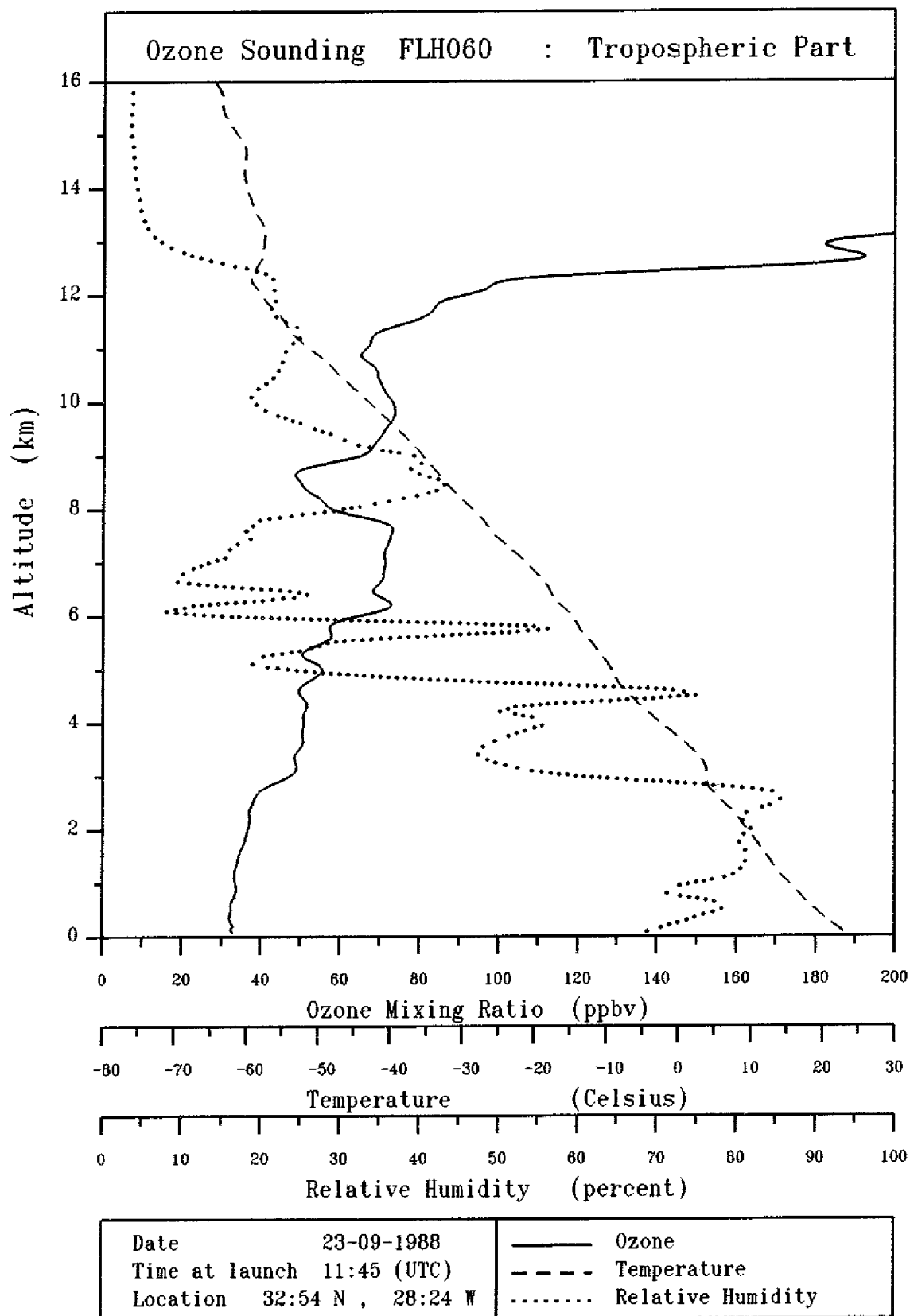
— Ozone
 --- Temperature
 Relative Humidity

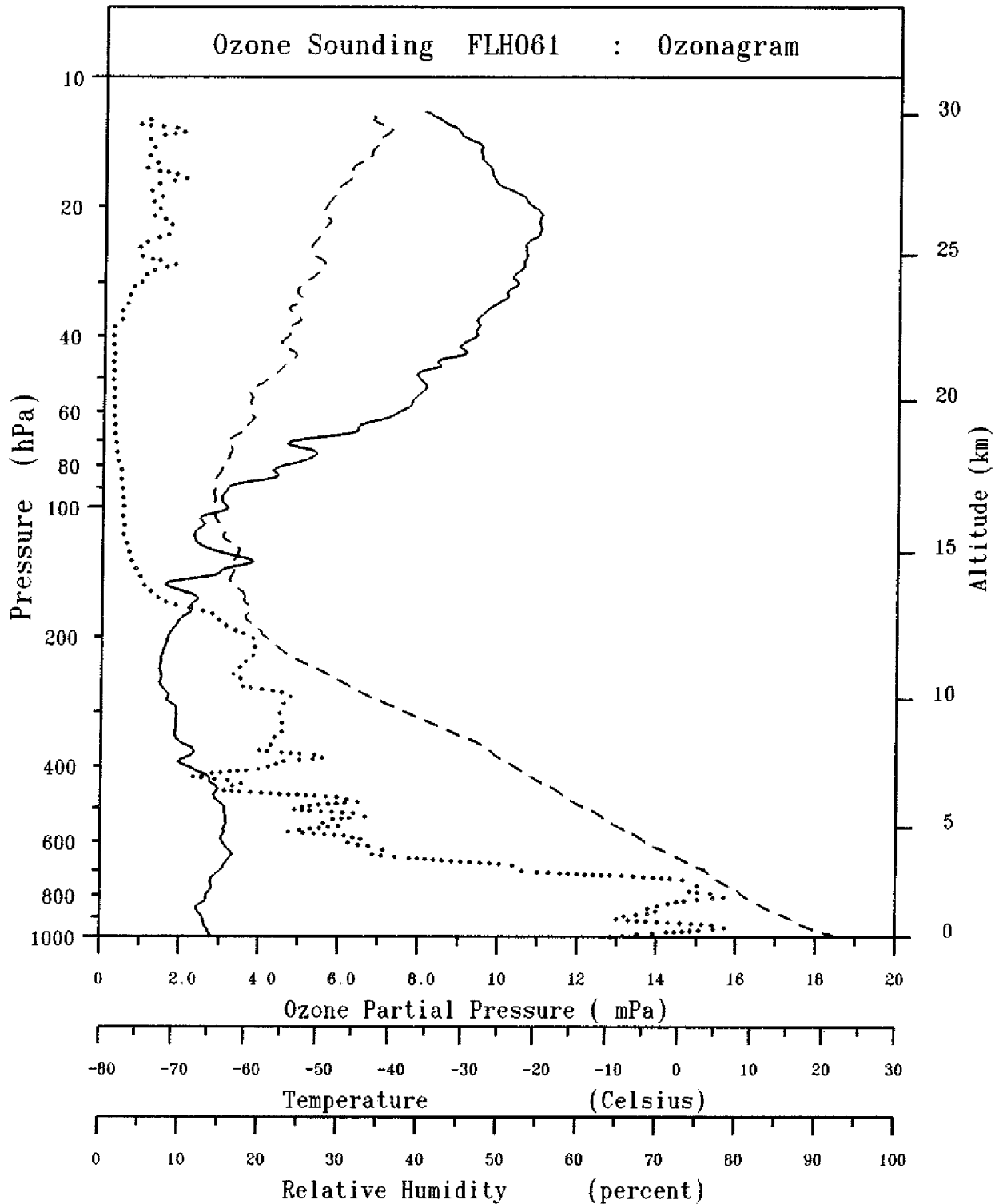


Date	22-09-1988	—	Ozone
Time at launch	14:20 (UTC)	- - -	Temperature
Location	37:07 N , 26:00 W	.....	Relative Humidity



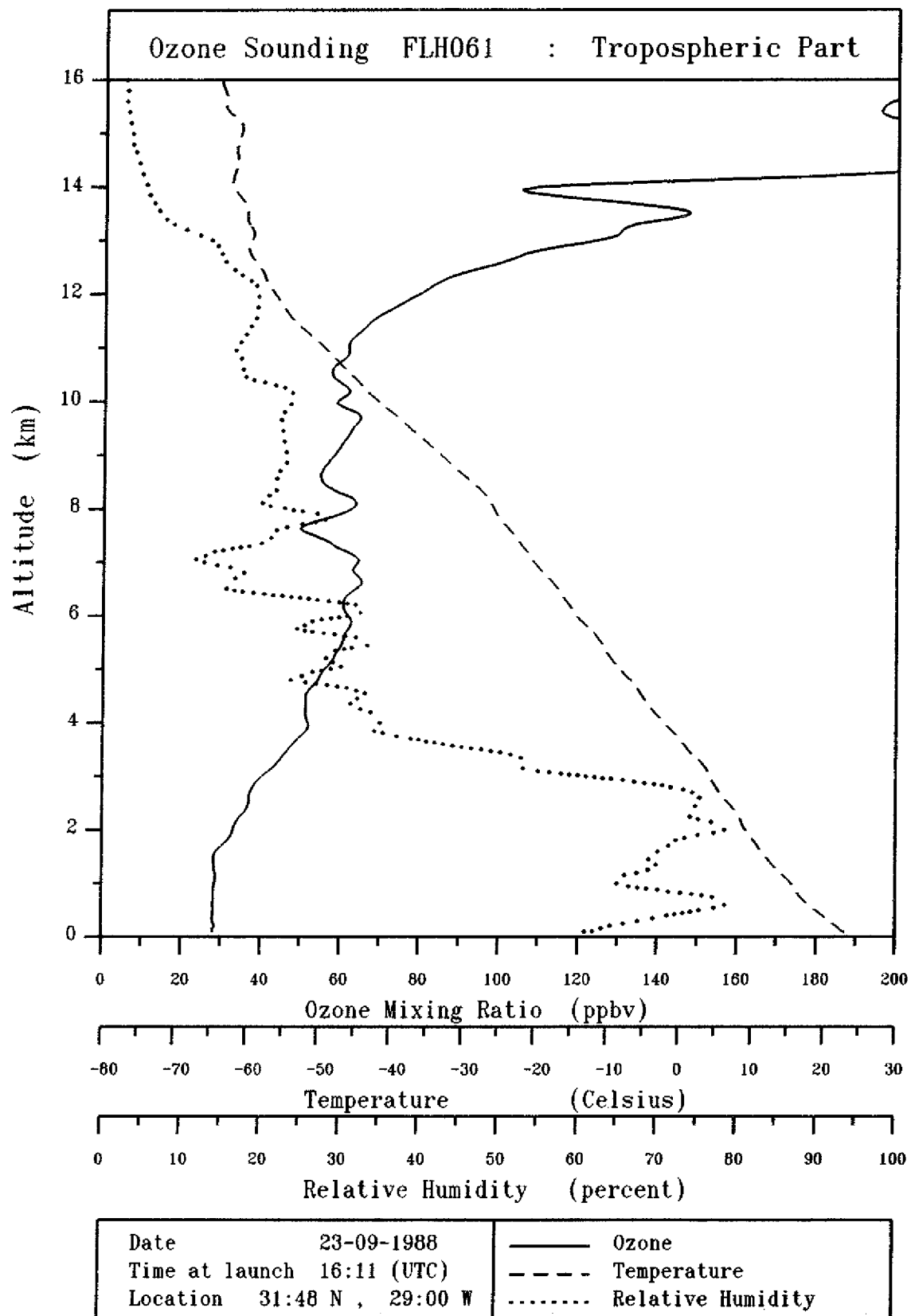
Date	23-09-1988	—	Ozone
Time at launch	11:45 (UTC)	- - - -	Temperature
Location	32:54 N , 28:24 W	.....	Relative Humidity

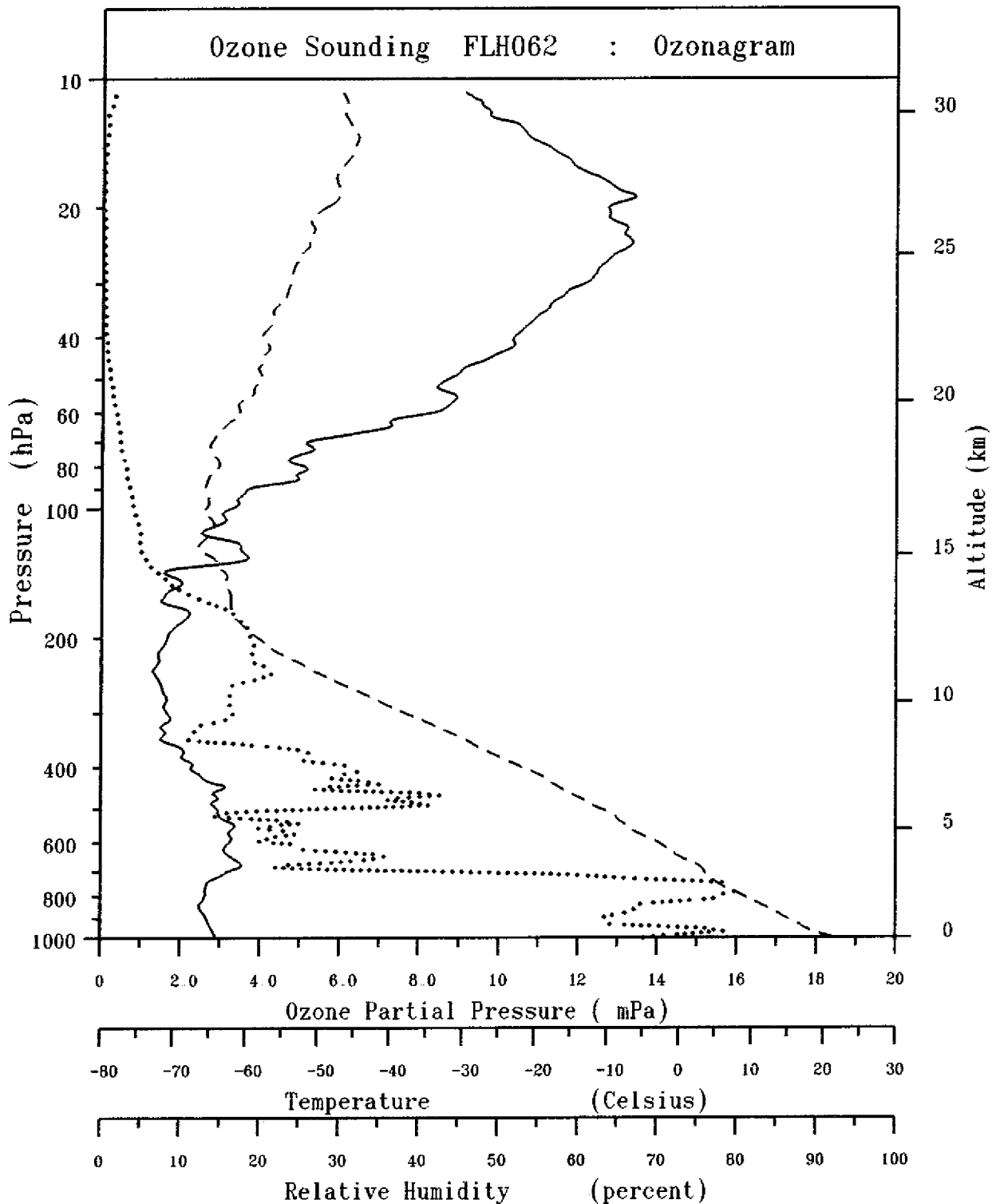




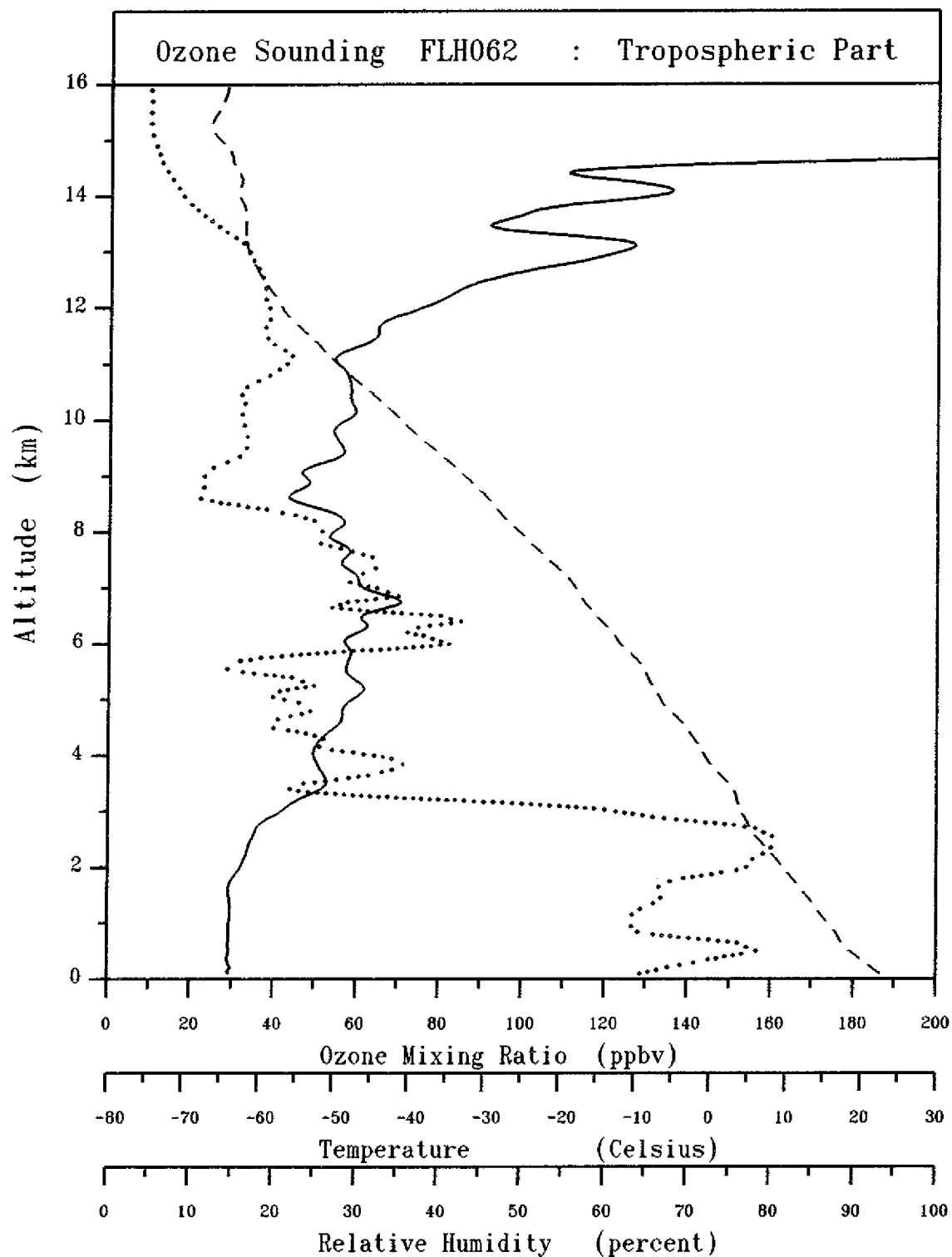
Date 23-09-1988
 Time at launch 16:11 (UTC)
 Location 31:48 N , 29:00 W

— Ozone
 --- Temperature
 Relative Humidity



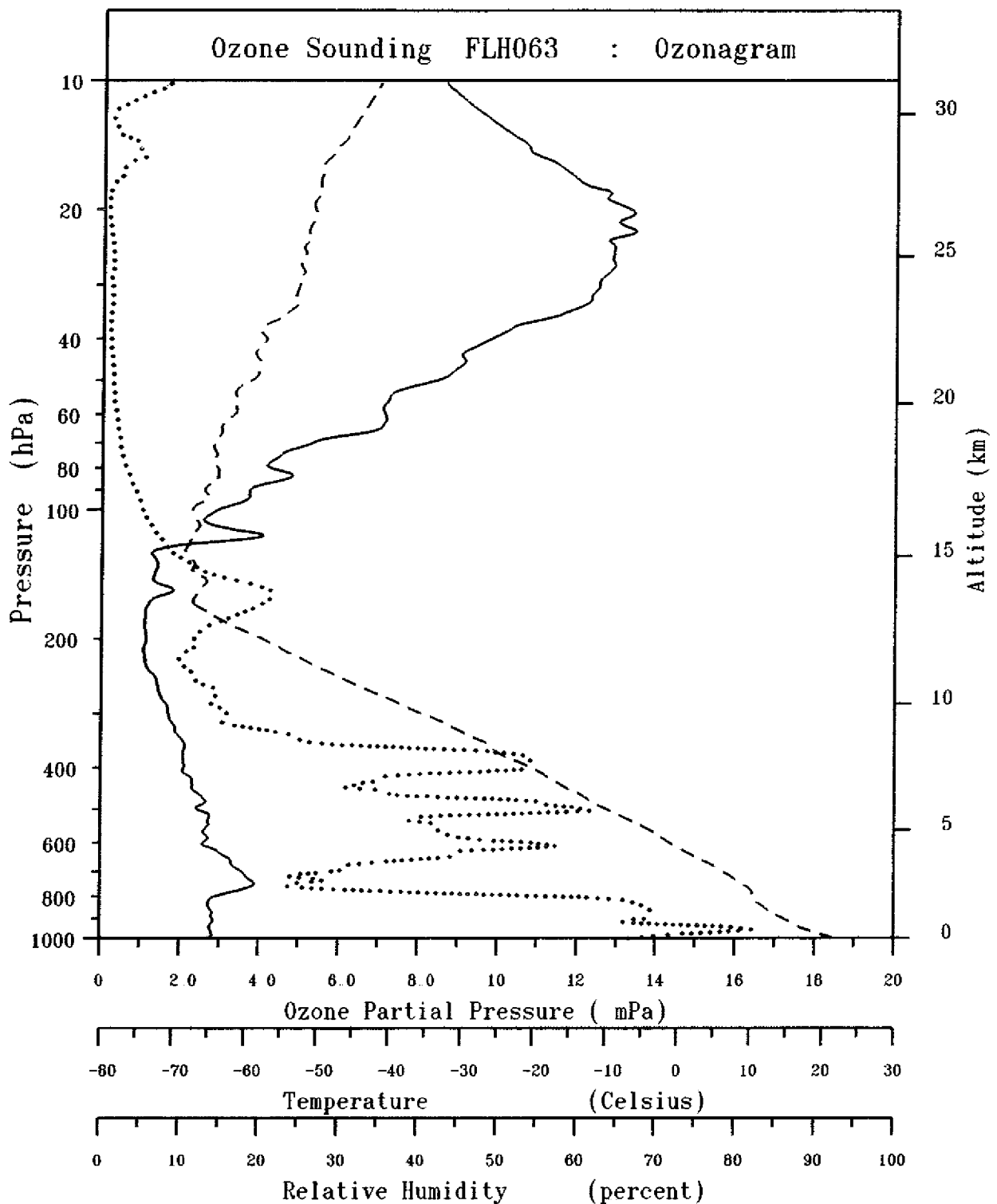


Date	23-09-1988	—	Ozone
Time at launch	22:45 (UTC)	- - - -	Temperature
Location	30:45 N , 29:36 W	.....	Relative Humidity



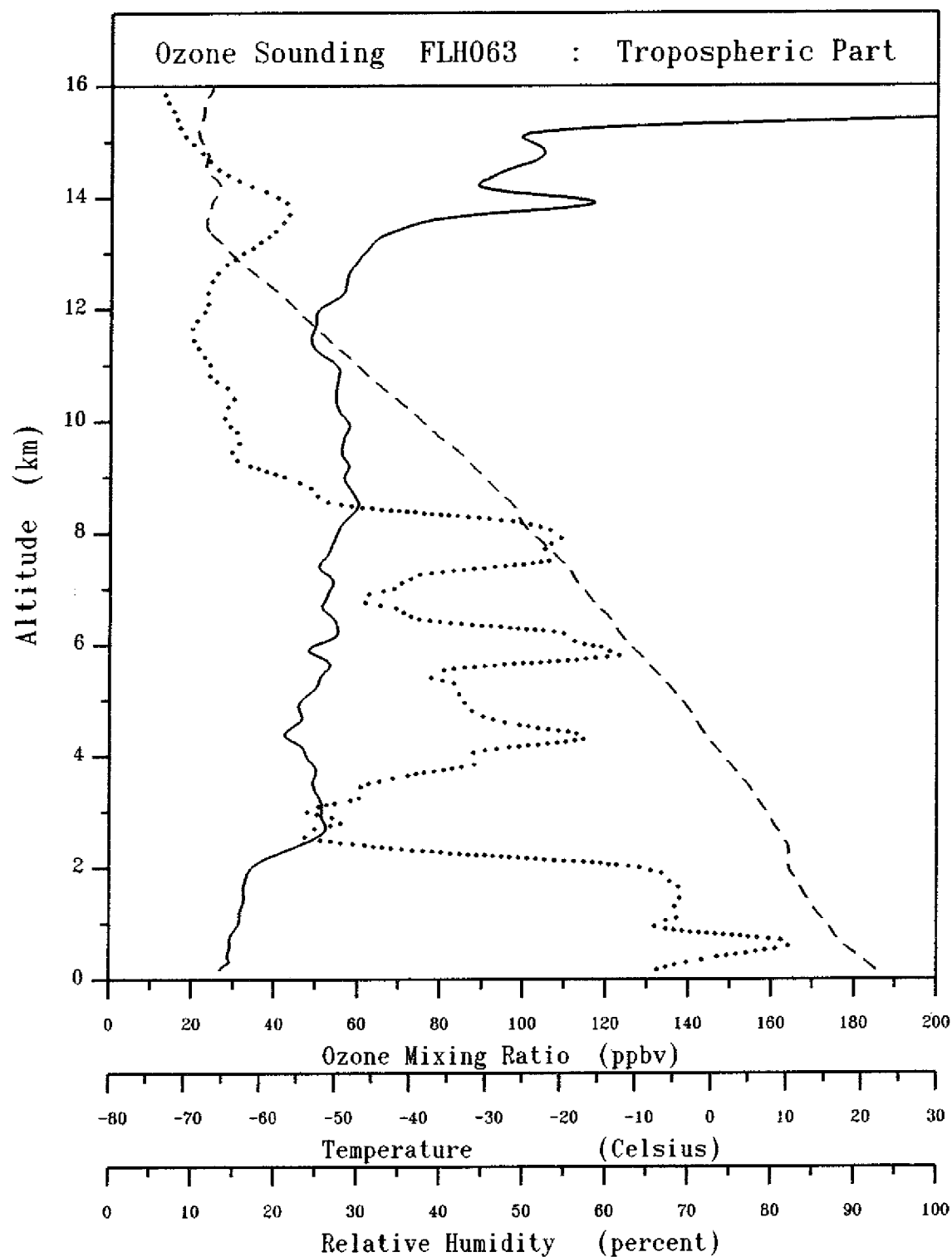
Date 23-09-1988
 Time at launch 22:45 (UTC)
 Location 30:45 N , 29:36 W

——— Ozone
 - - - - Temperature
 Relative Humidity



Date 24-09-1988
 Time at launch 12:15 (UTC)
 Location 28:15 N , 30:00 W

— Ozone
 --- Temperature
 Relative Humidity



Date 24-09-1988

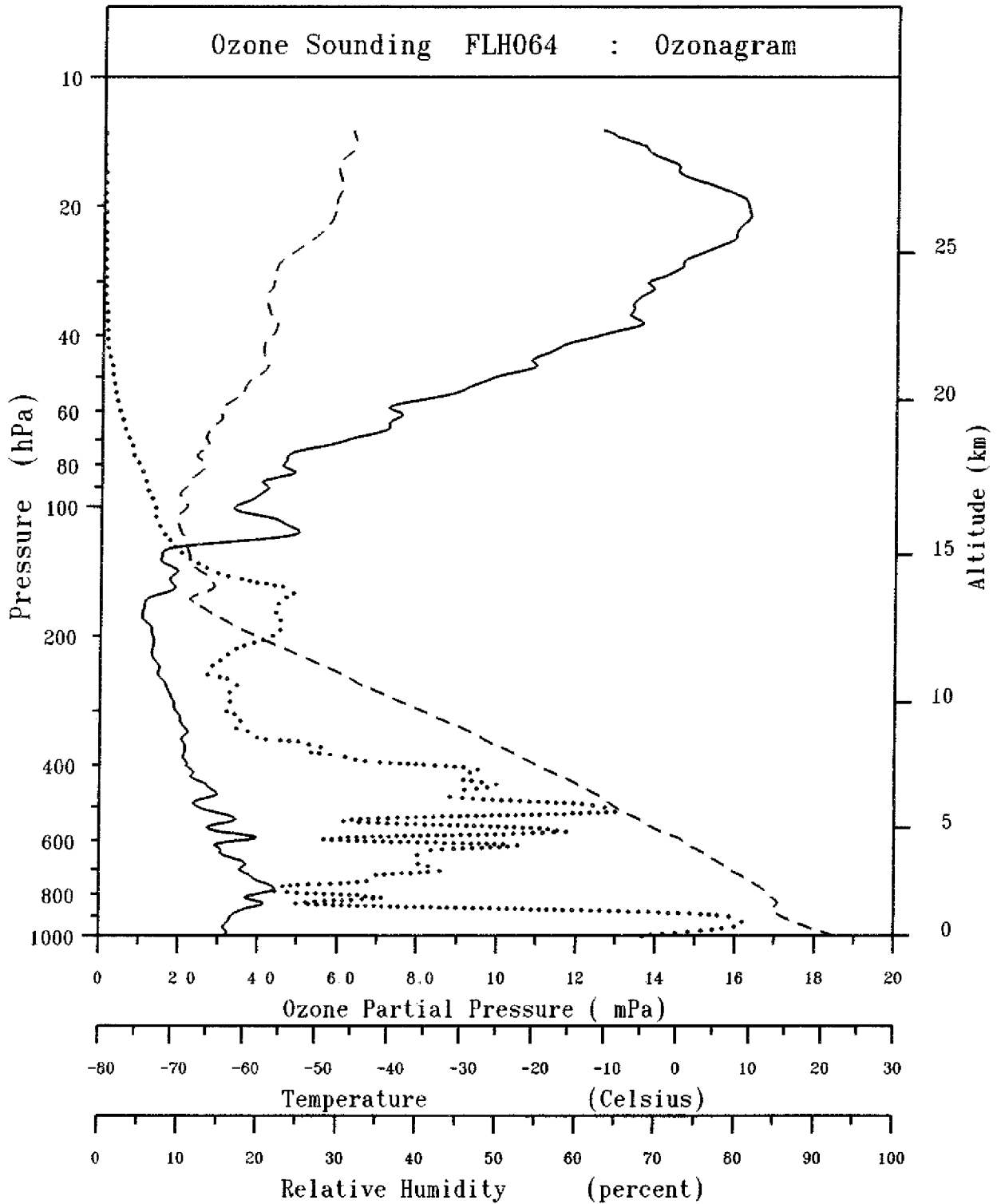
Time at launch 12:15 (UTC)

Location 28:15 N , 30:00 W

— Ozone

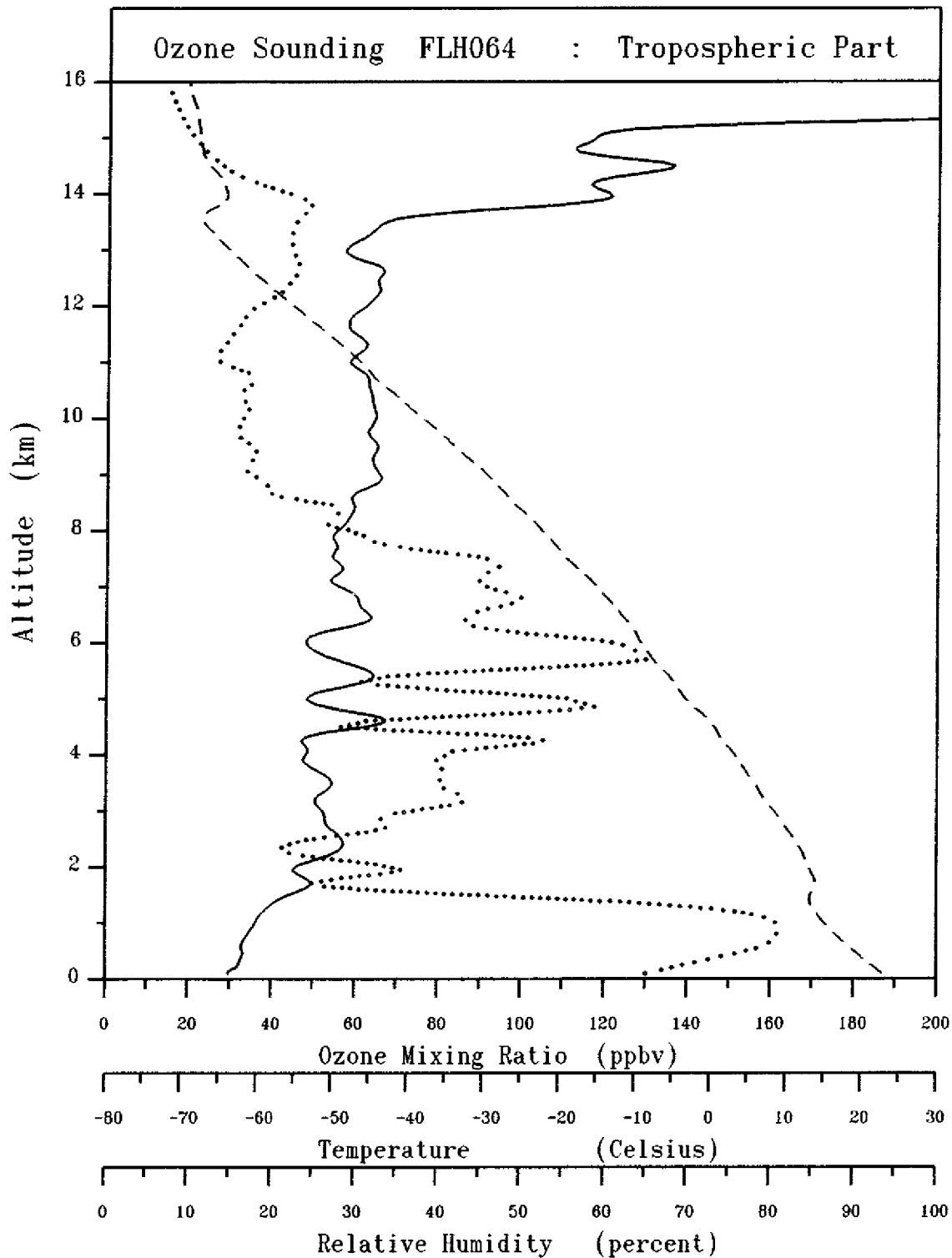
- - - Temperature

..... Relative Humidity



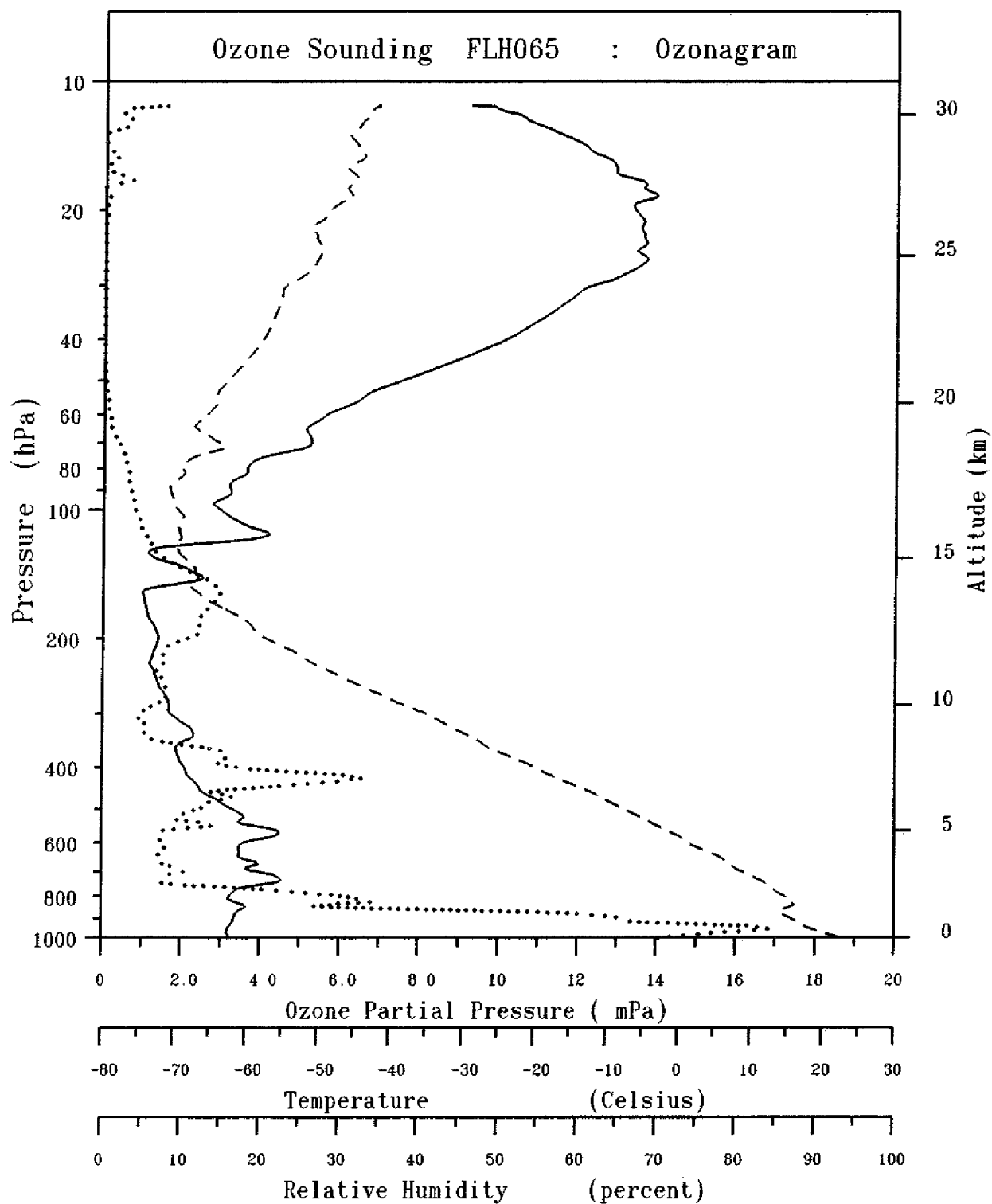
Date 24-09-1988
 Time at launch 21:15 (UTC)
 Location 26:03 N , 30:00 W

——— Ozone
 - - - - Temperature
 Relative Humidity



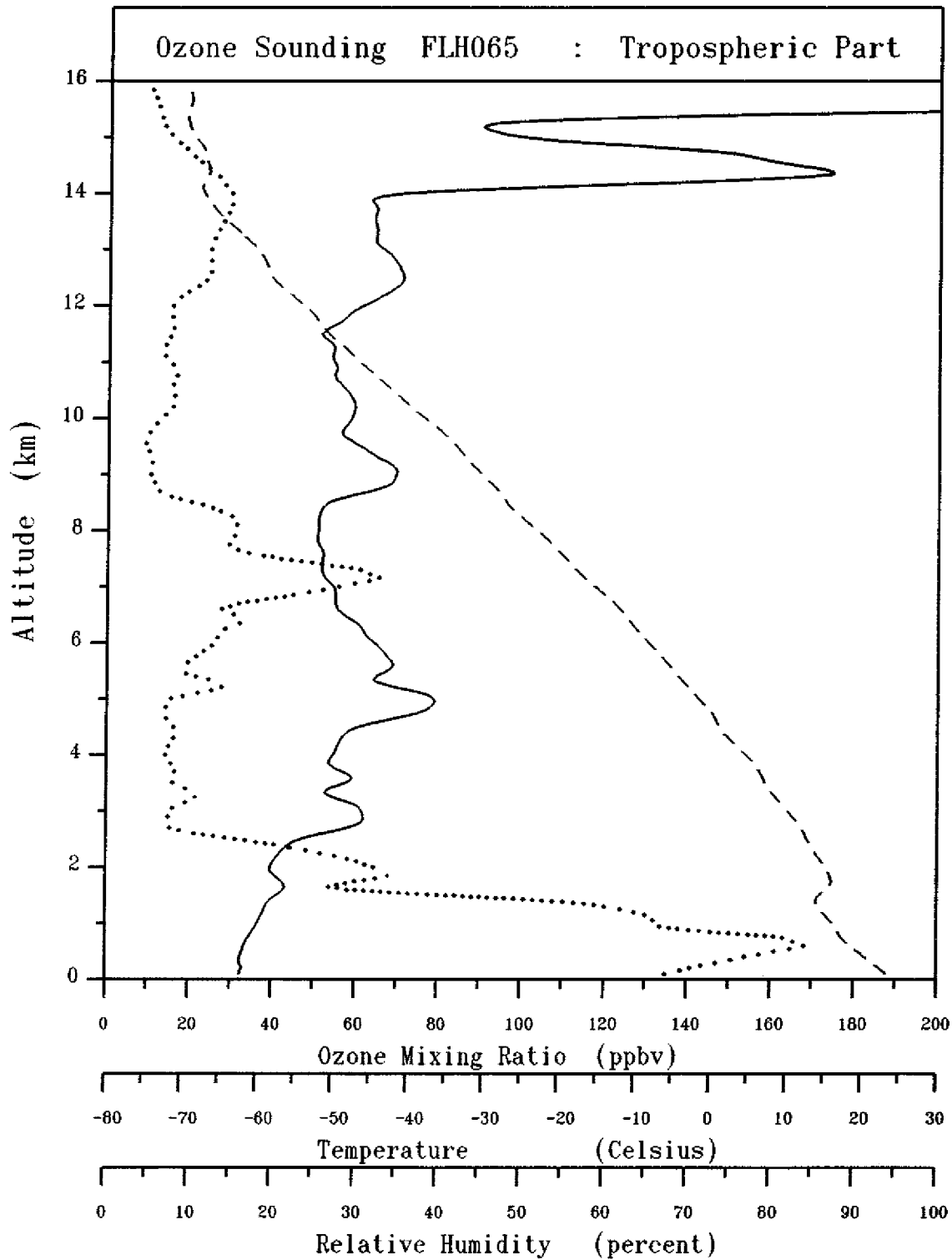
Date 24-09-1988
 Time at launch 21:15 (UTC)
 Location 26:03 N , 30:00 W

— Ozone
 - - - Temperature
 Relative Humidity

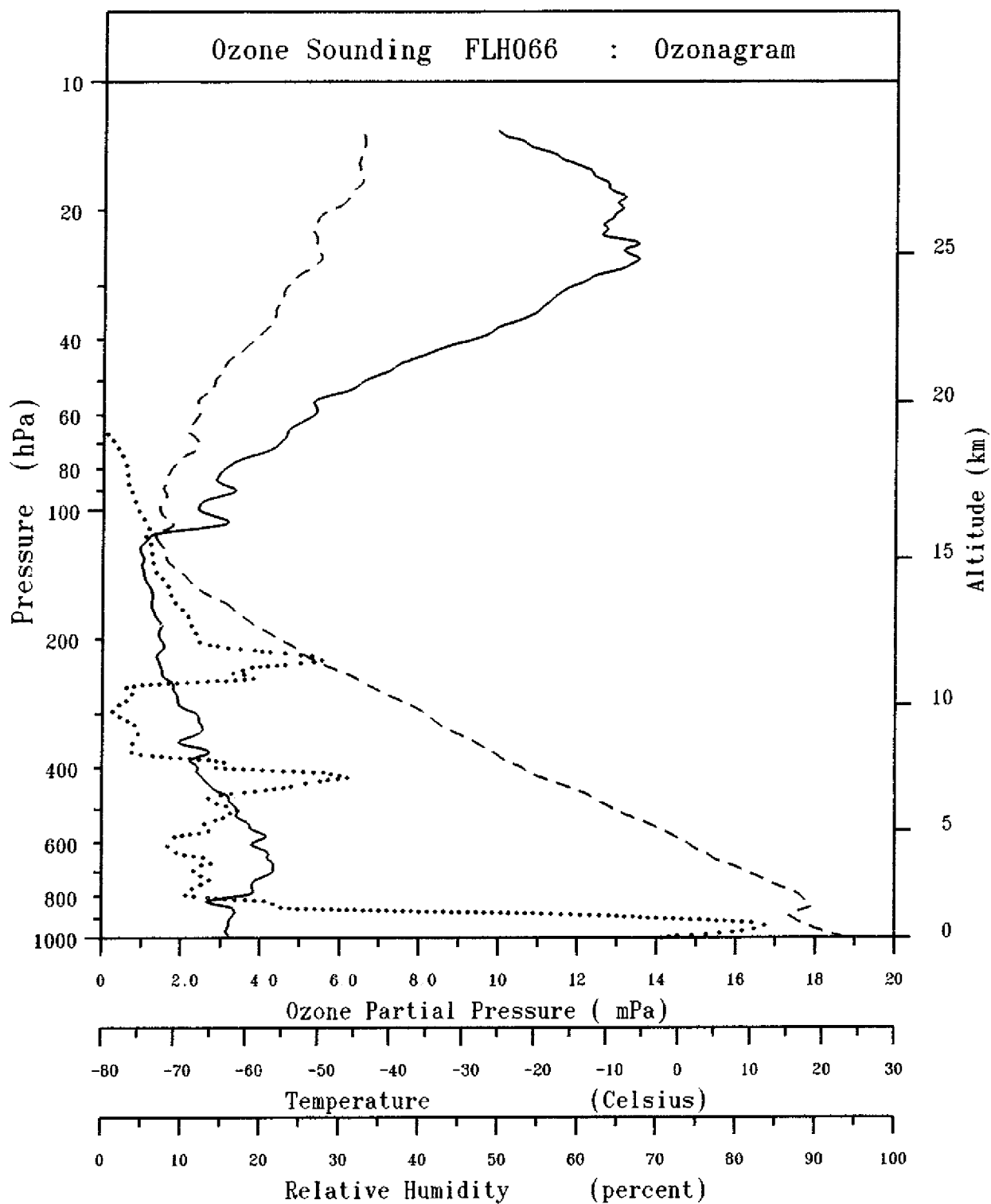


Date 25-09-1988
 Time at launch 12:10 (UTC)
 Location 22:38 N , 30:00 W

— Ozone
 --- Temperature
 Relative Humidity

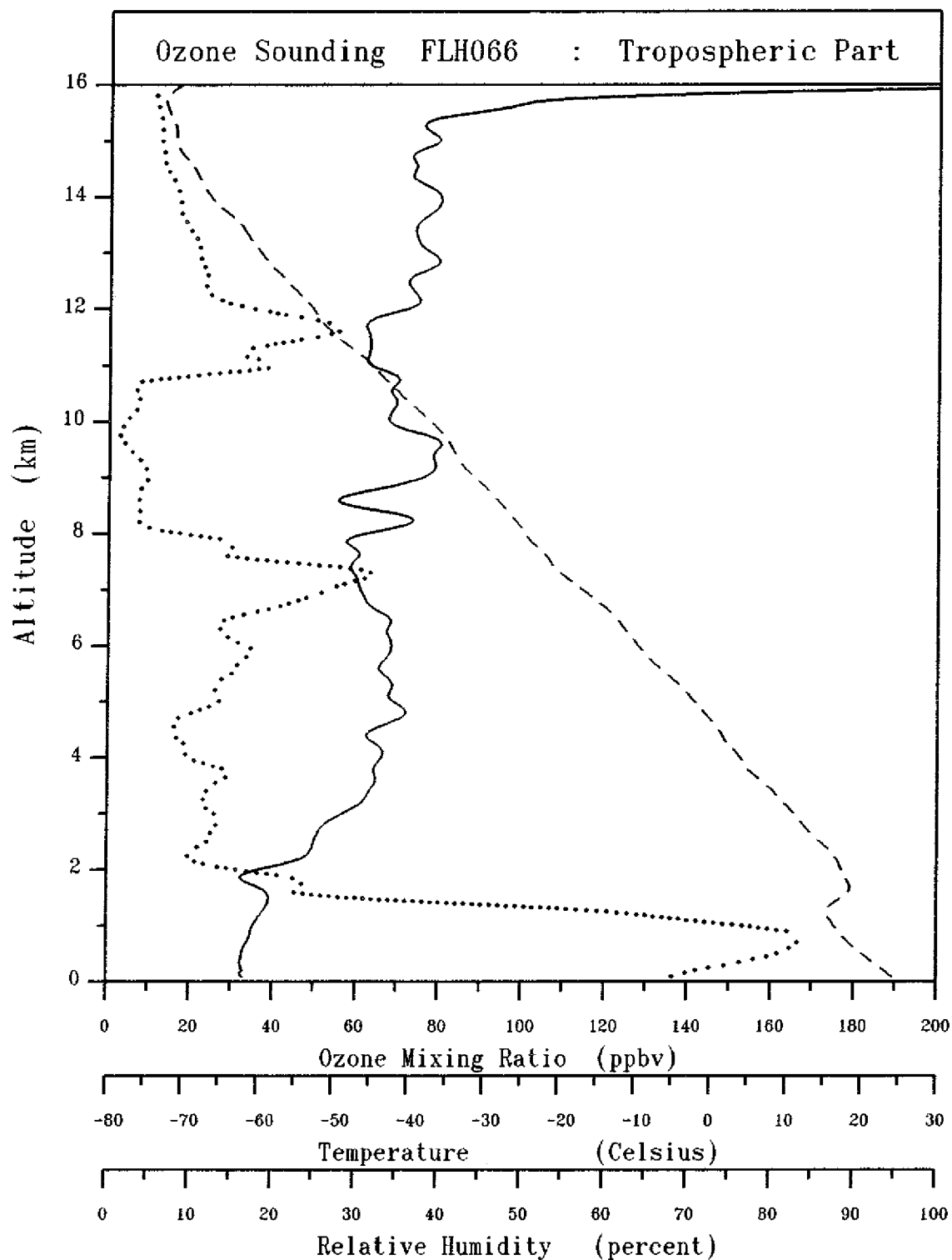


Date	25-09-1988	—	Ozone
Time at launch	12:10 (UTC)	- - -	Temperature
Location	22:38 N , 30:00 W	.....	Relative Humidity



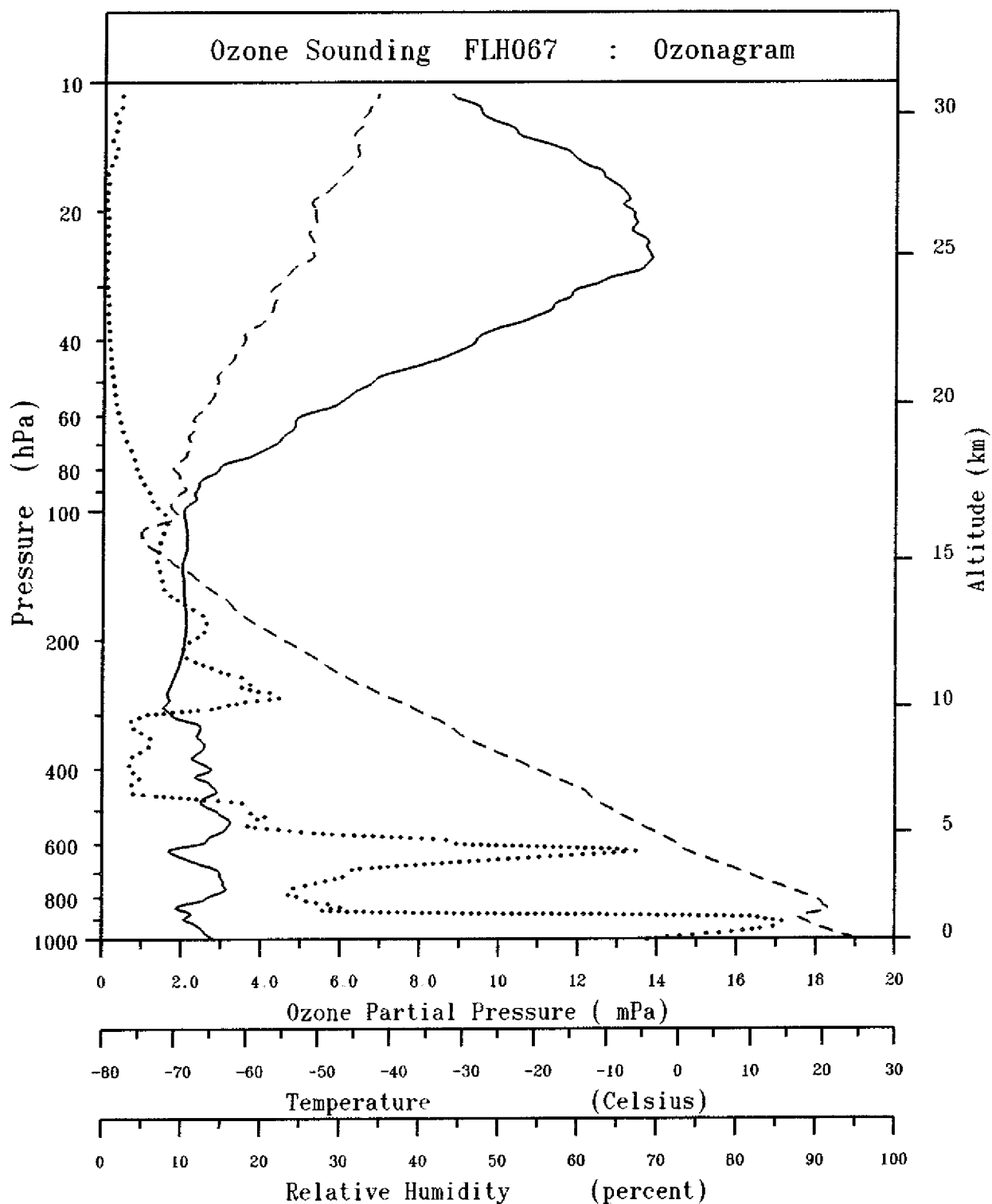
Date 26-09-1988
 Time at launch 02:00 (UTC)
 Location 19:27 N, 30:00 W

— Ozone
 --- Temperature
 Relative Humidity

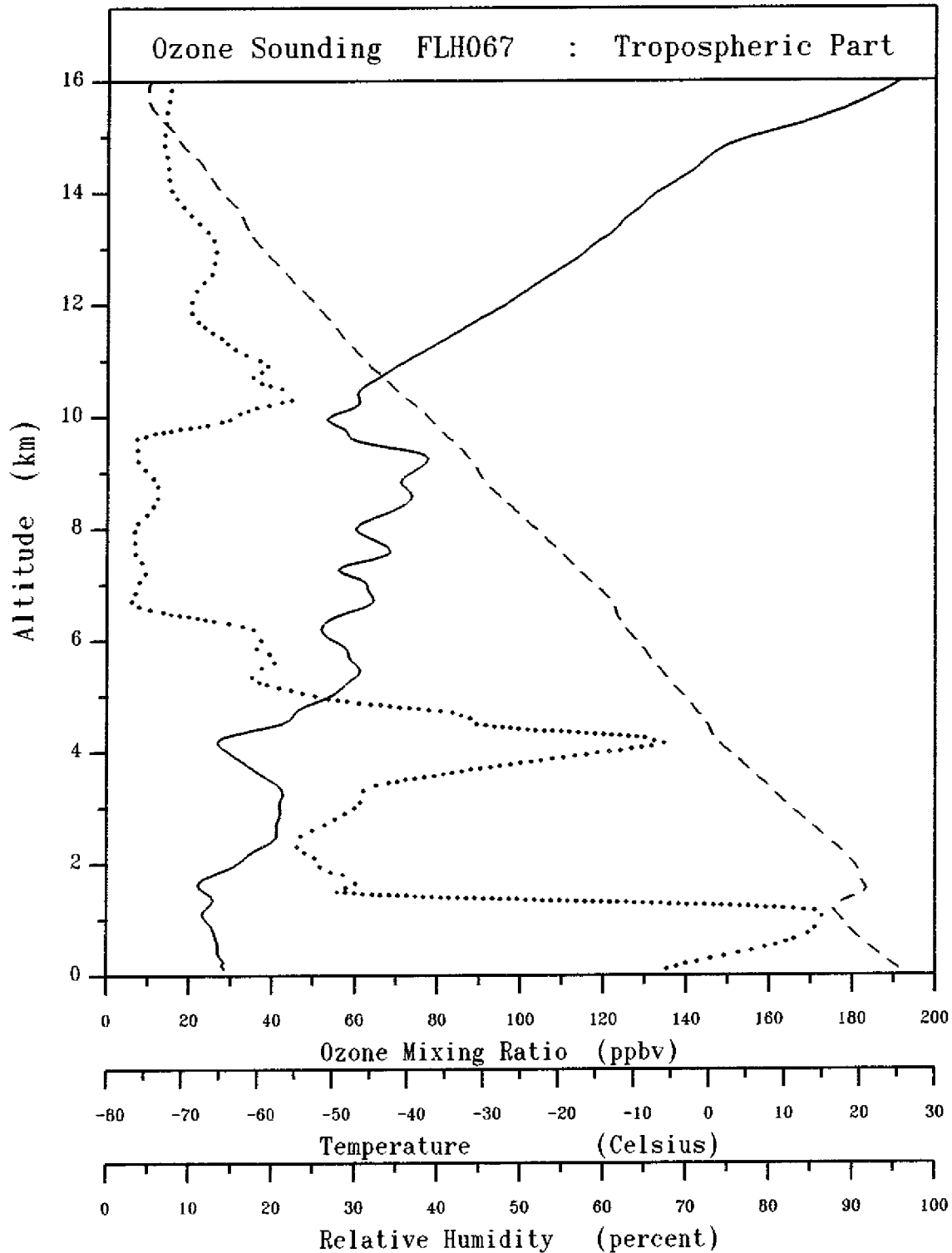


Date 26-09-1988
 Time at launch 02:00 (UTC)
 Location 19:27 N , 30:00 W

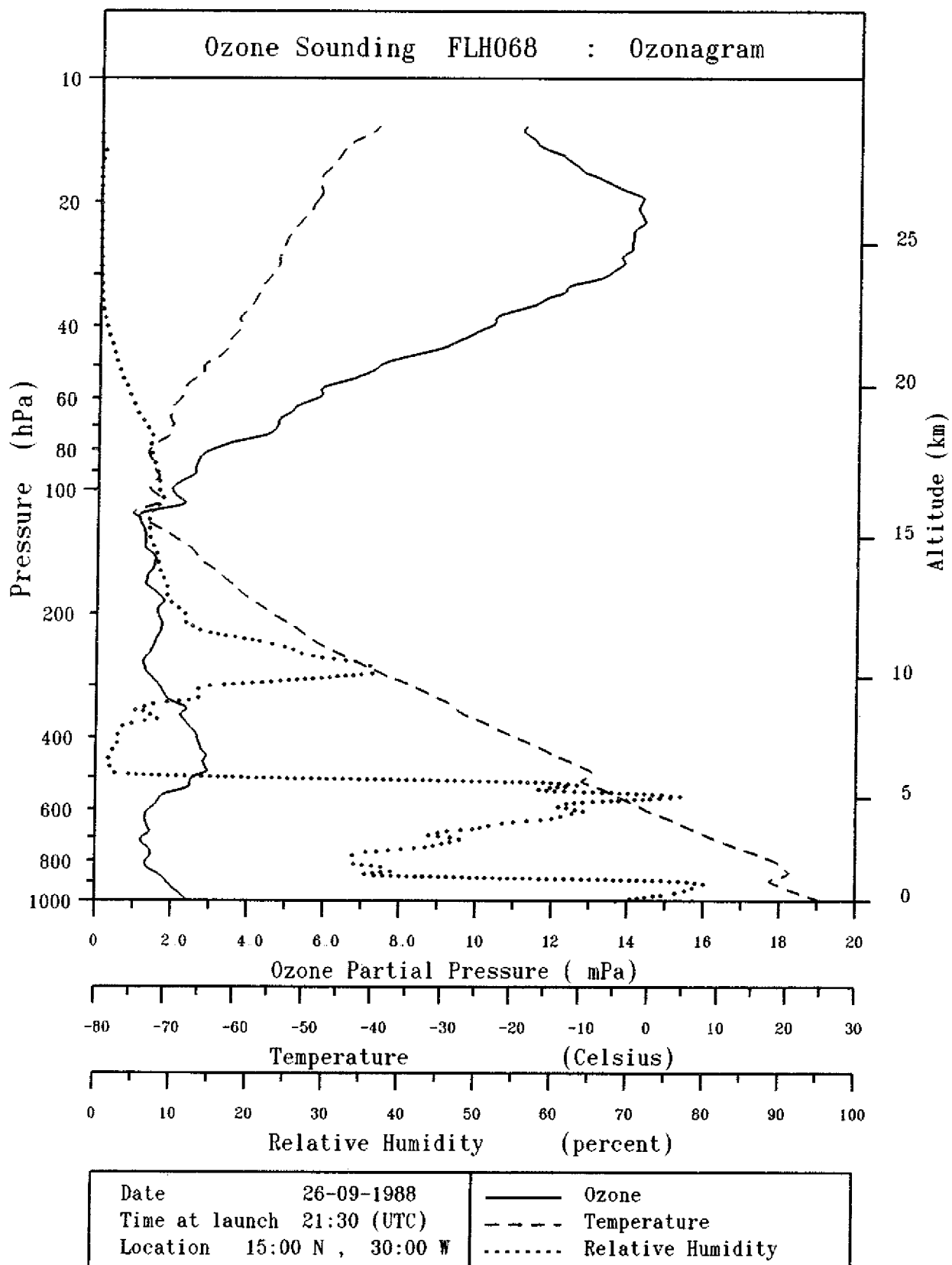
— Ozone
 - - - Temperature
 Relative Humidity

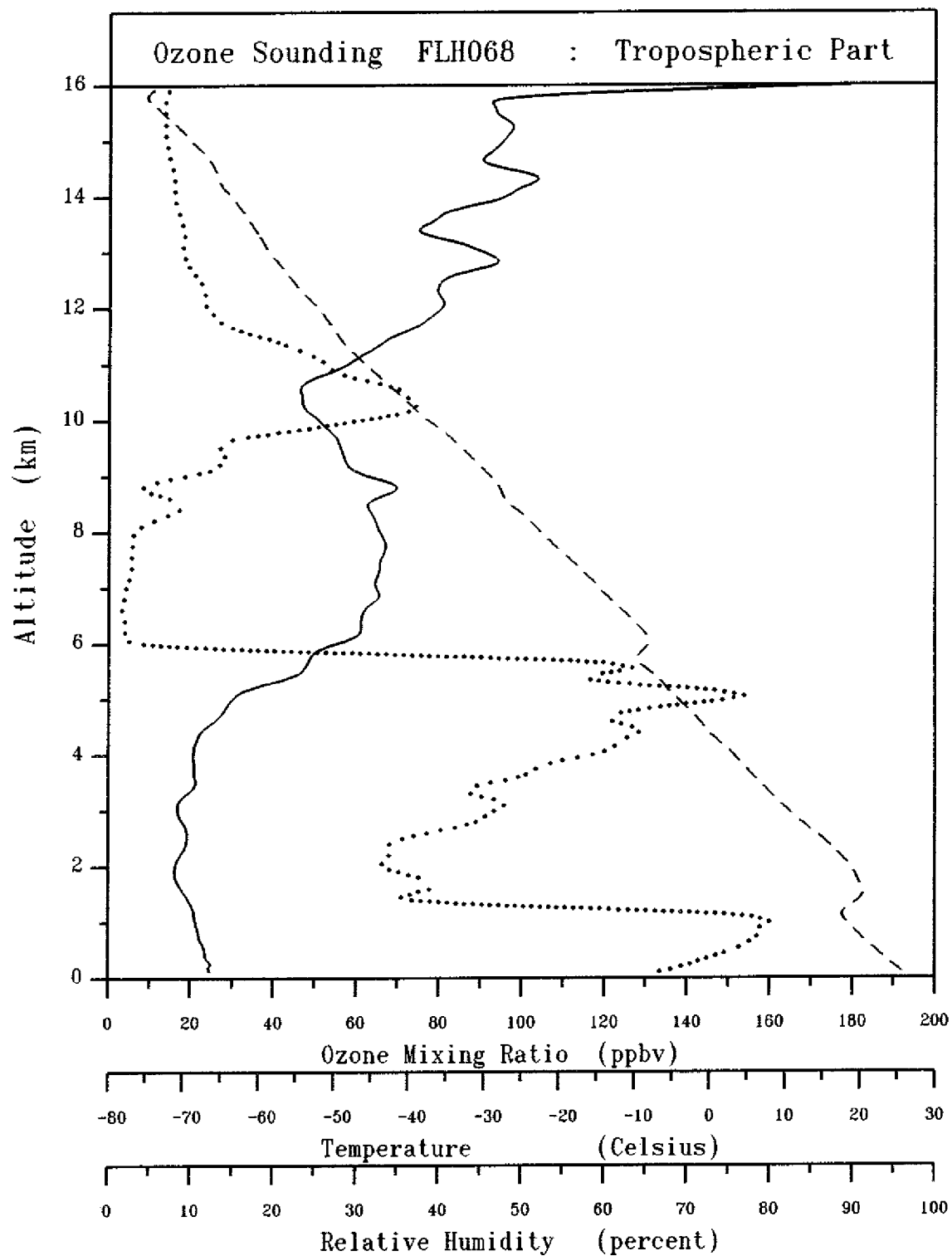


Date	26-09-1988	—	Ozone
Time at launch	11:30 (UTC)	- - -	Temperature
Location	17:13 N , 30:00 W	.....	Relative Humidity



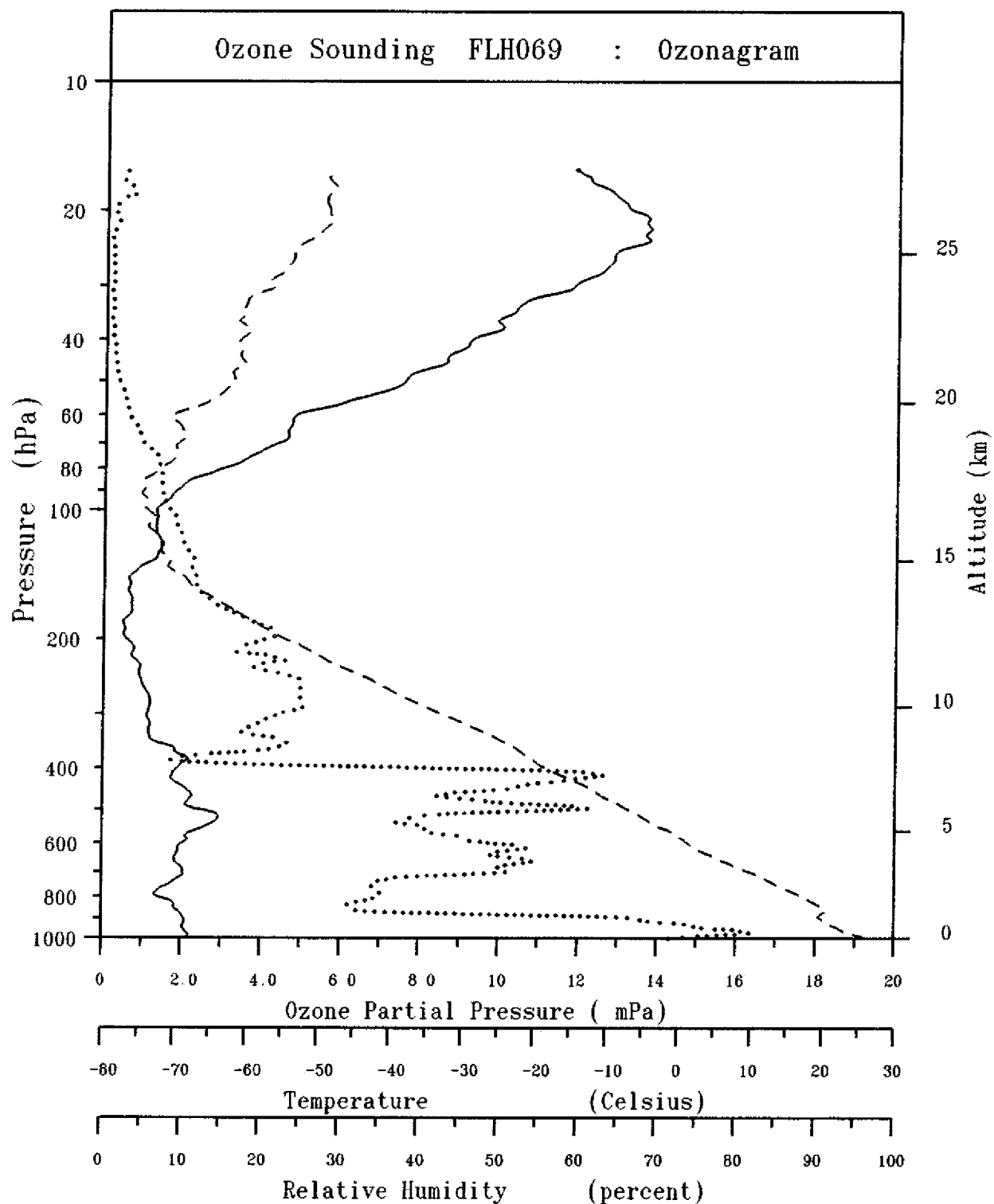
Date	26-09-1988	—	Ozone
Time at launch	11:30 (UTC)	- - -	Temperature
Location	17:13 N , 30:00 W	.....	Relative Humidity



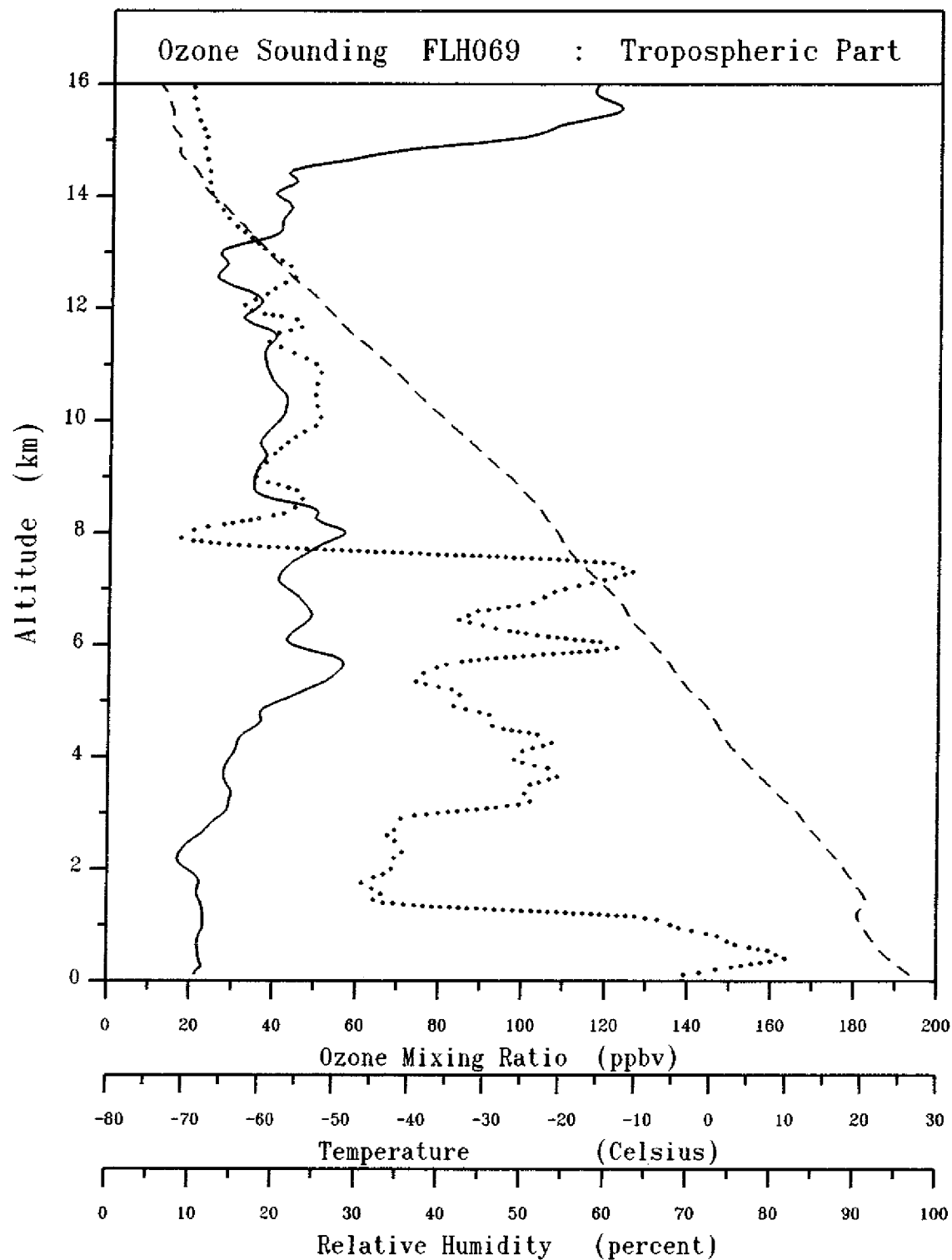


Date 26-09-1988
 Time at launch 21:30 (UTC)
 Location 15:00 N , 30:00 W

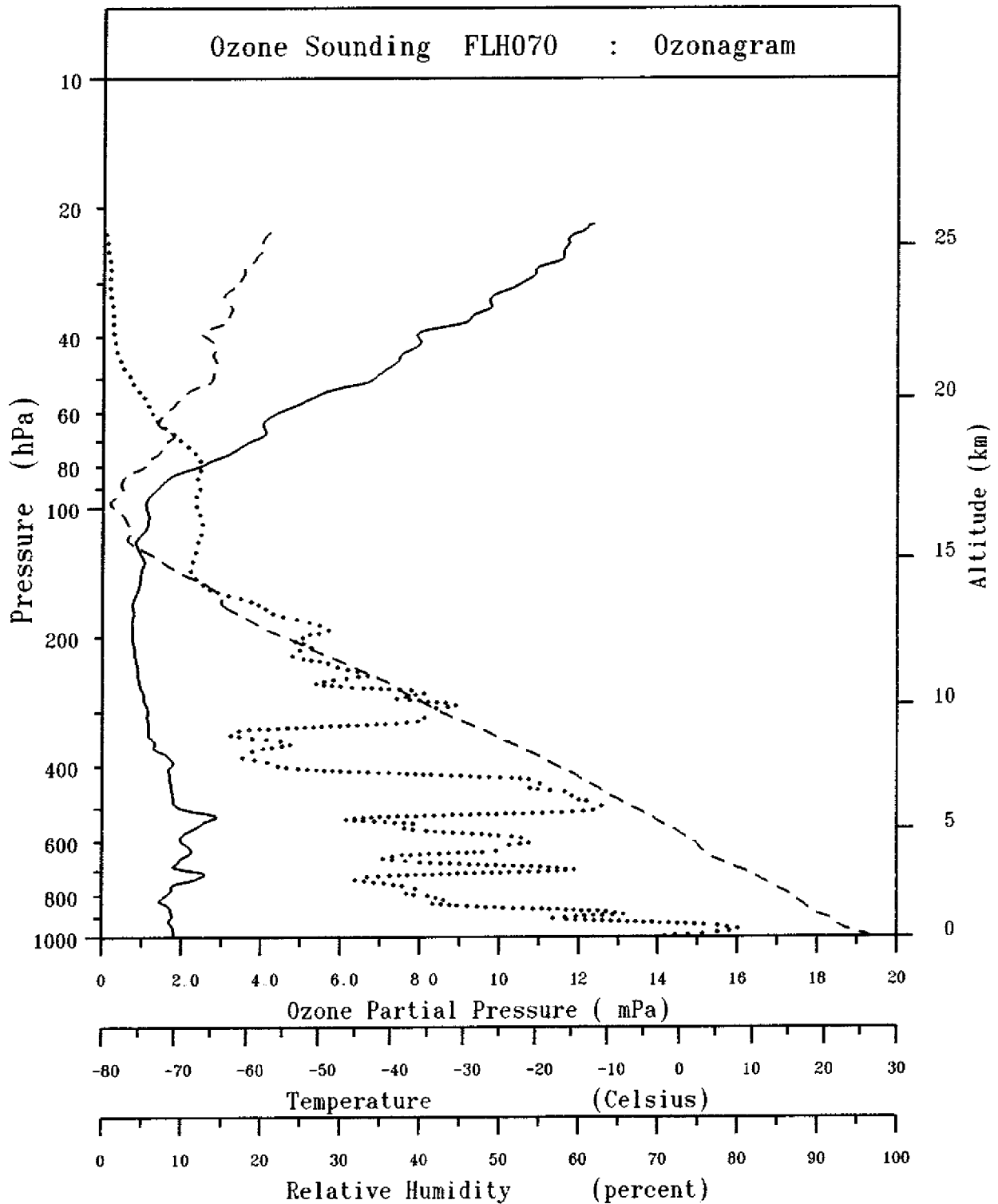
— Ozone
 - - - Temperature
 Relative Humidity



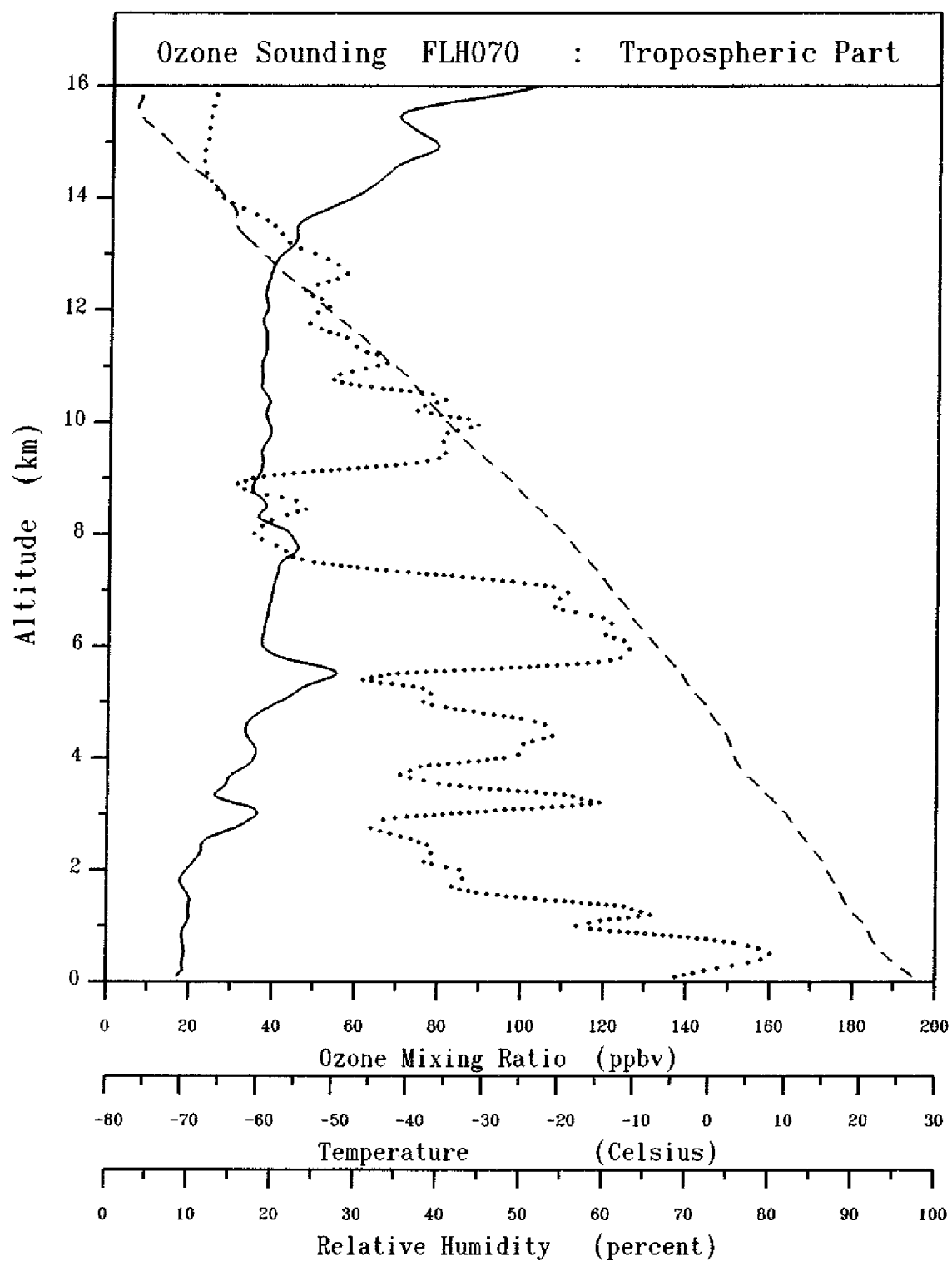
Date	27-09-1988	—	Ozone
Time at launch	11:50 (UTC)	- - - -	Temperature
Location	11:51 N , 30:00 W	.....	Relative Humidity



Date	27-09-1988	—	Ozone
Time at launch	11:50 (UTC)	- - -	Temperature
Location	11:51 N , 30:00 W	.....	Relative Humidity

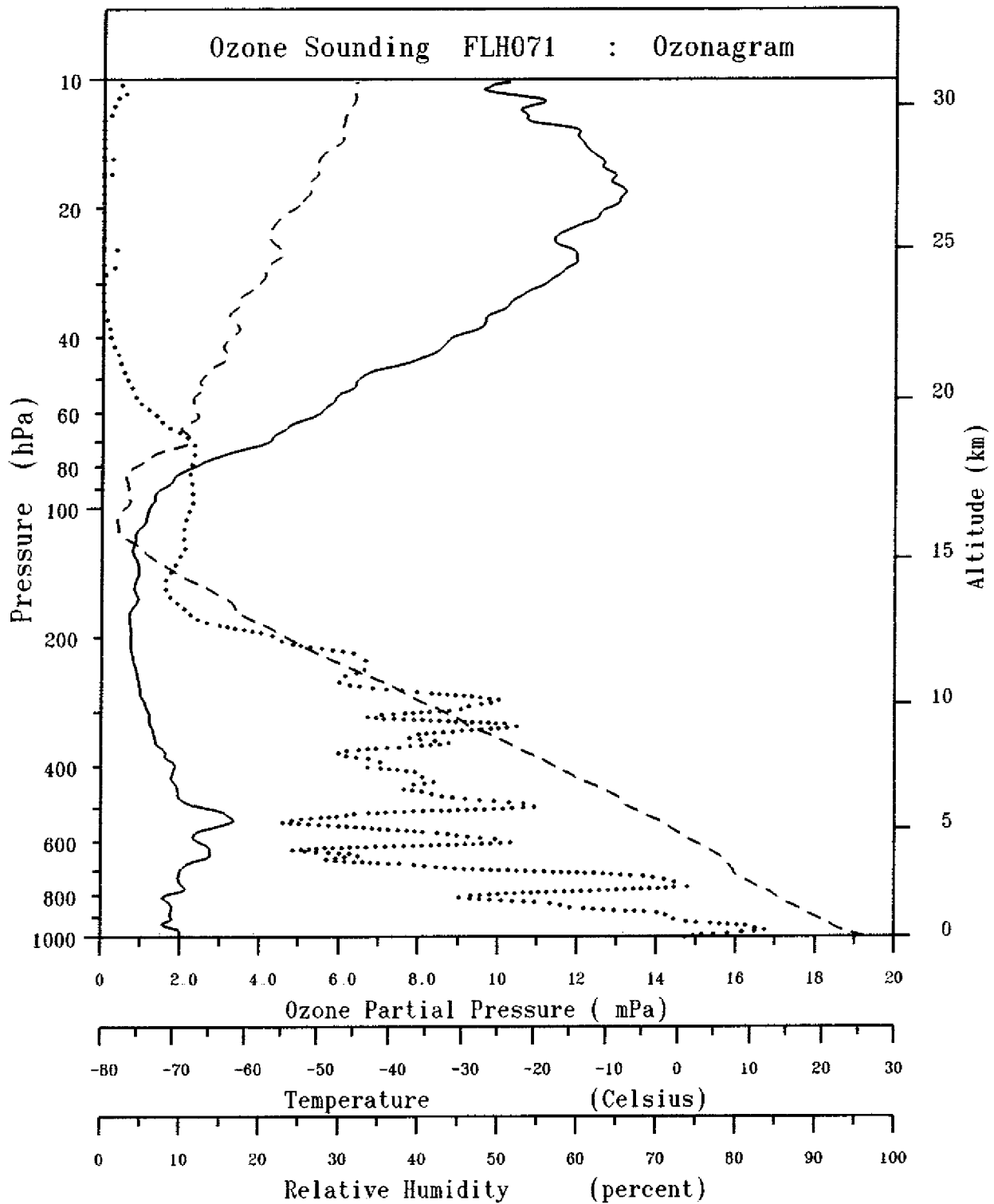


Date	27-09-1988	—	Ozone
Time at launch	18:35 (UTC)	- - - -	Temperature
Location	10:18 N , 30:00 W	.....	Relative Humidity

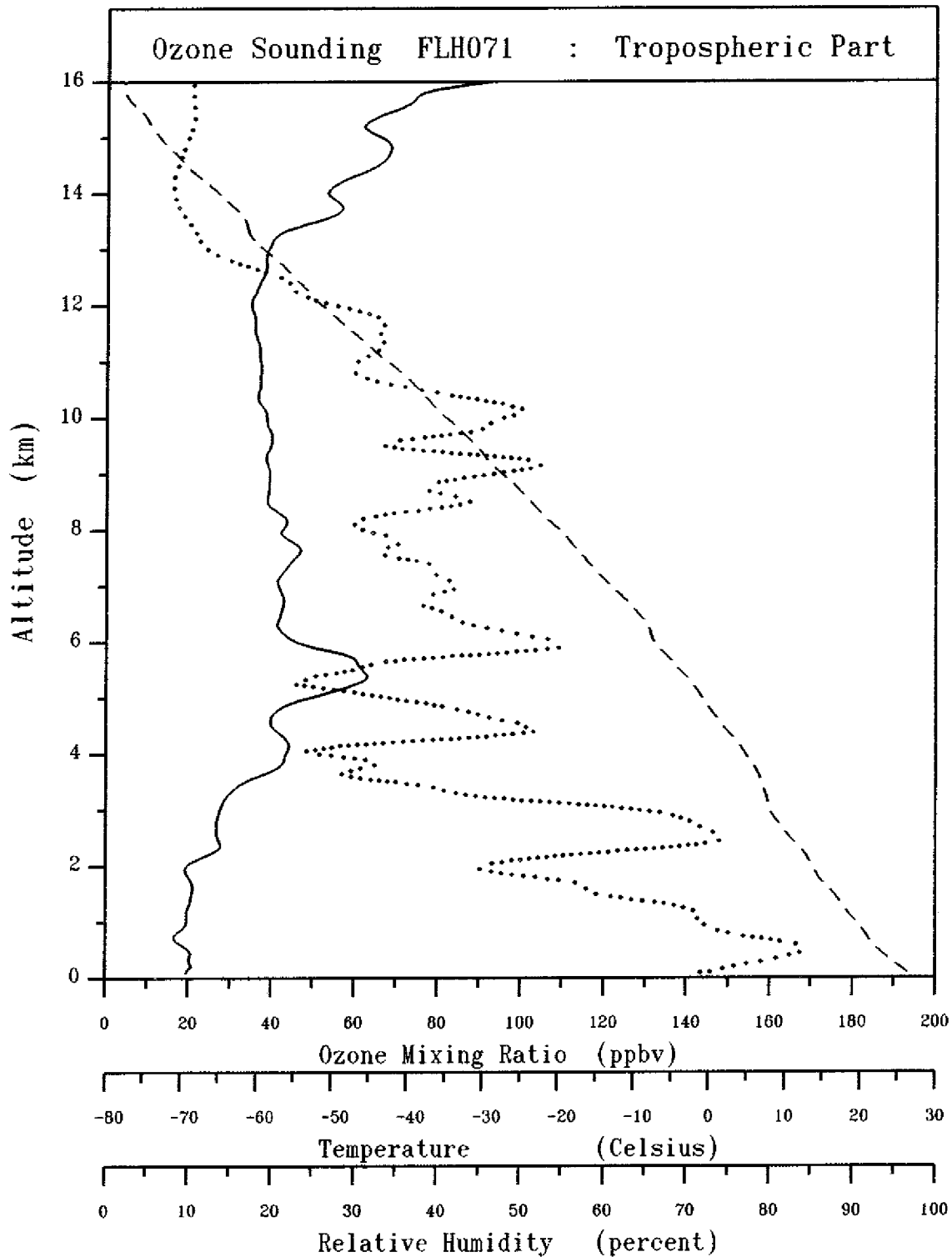


Date 27-09-1988
 Time at launch 18:35 (UTC)
 Location 10:18 N , 30:00 W

— Ozone
 - - - Temperature
 Relative Humidity

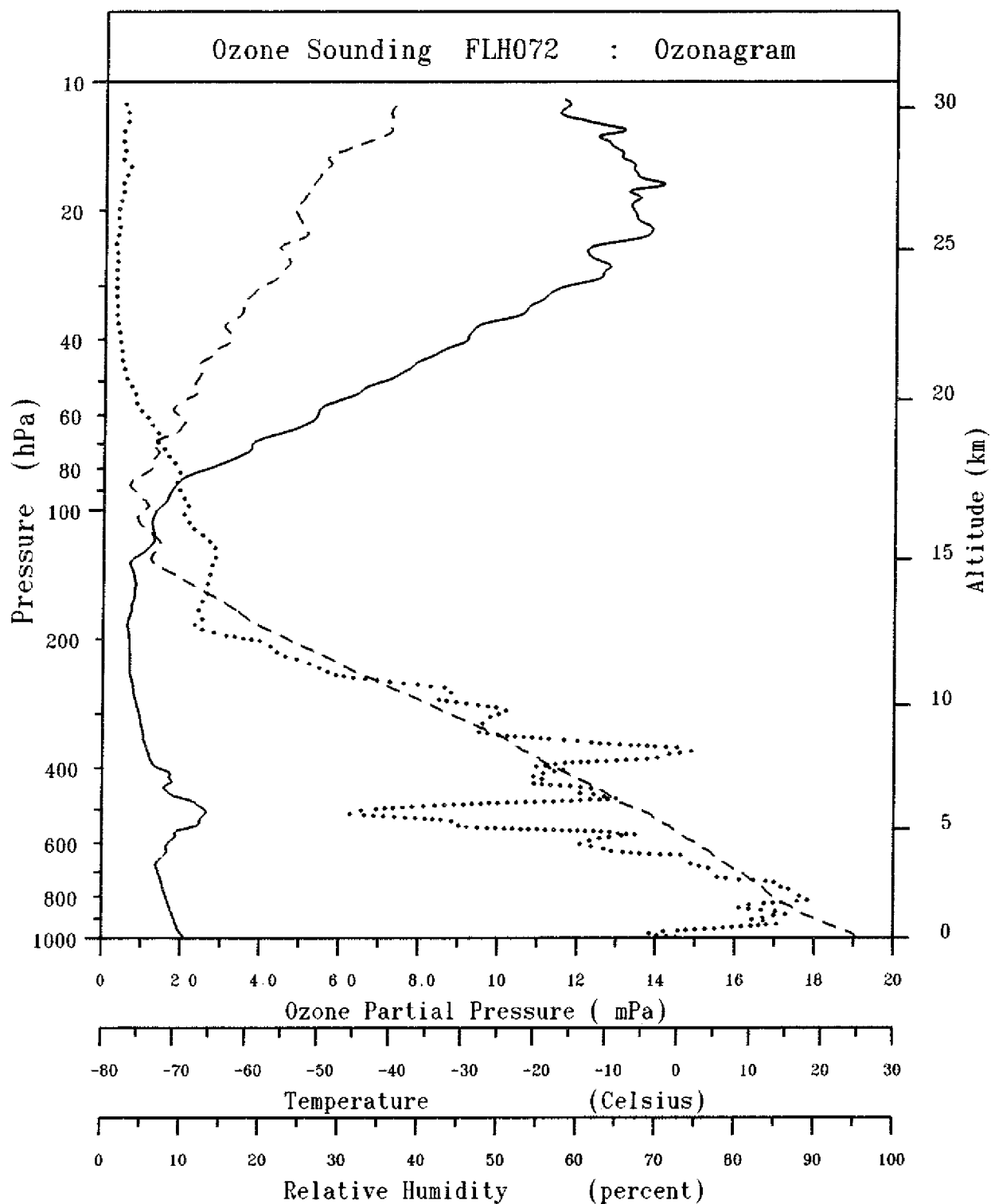


Date	28-09-1988	—	Ozone
Time at launch	01:15 (UTC)	- - -	Temperature
Location	8:48 N , 30:00 W	.....	Relative Humidity



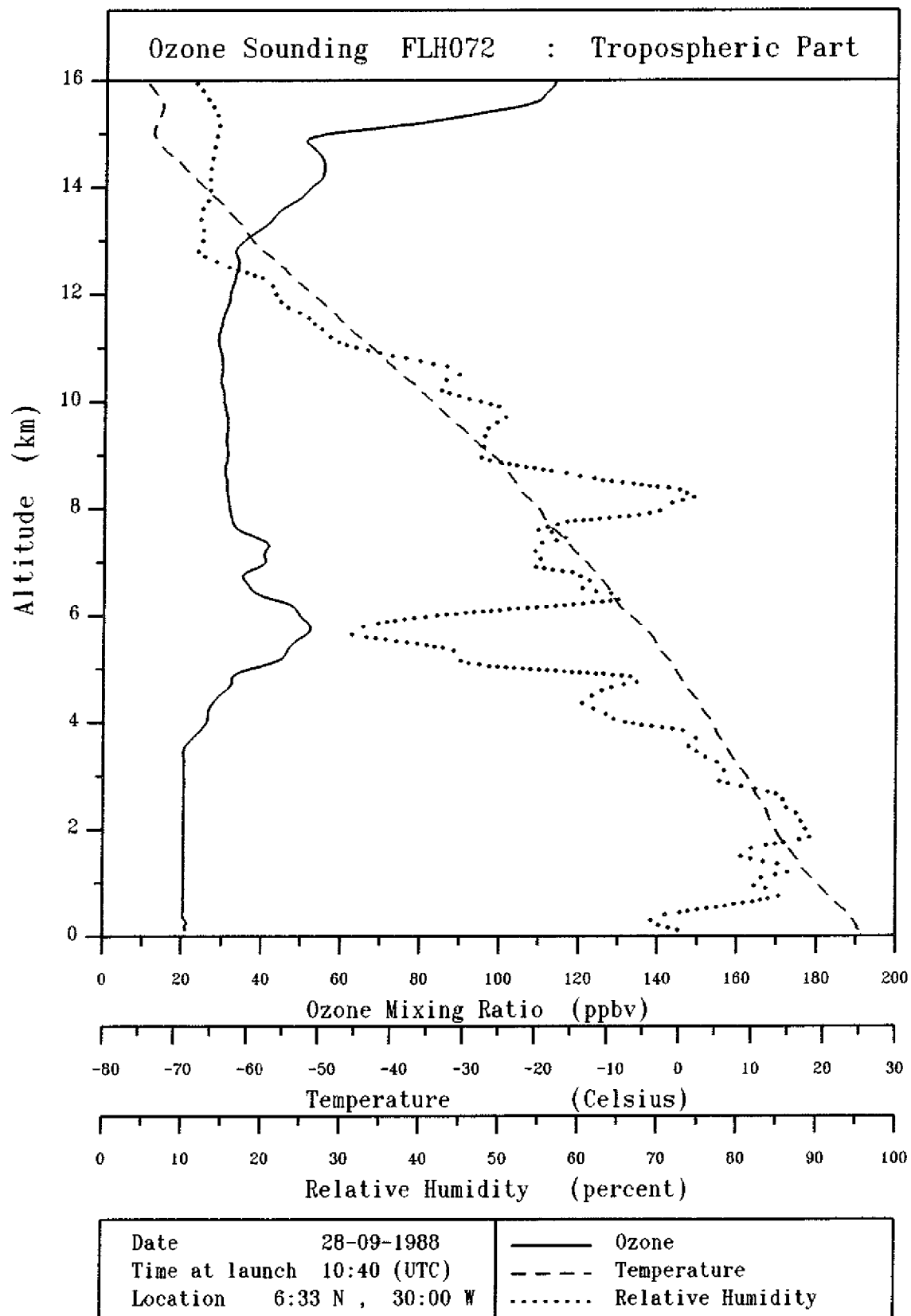
Date 28-09-1988
 Time at launch 01:15 (UTC)
 Location 8:48 N , 30:00 W

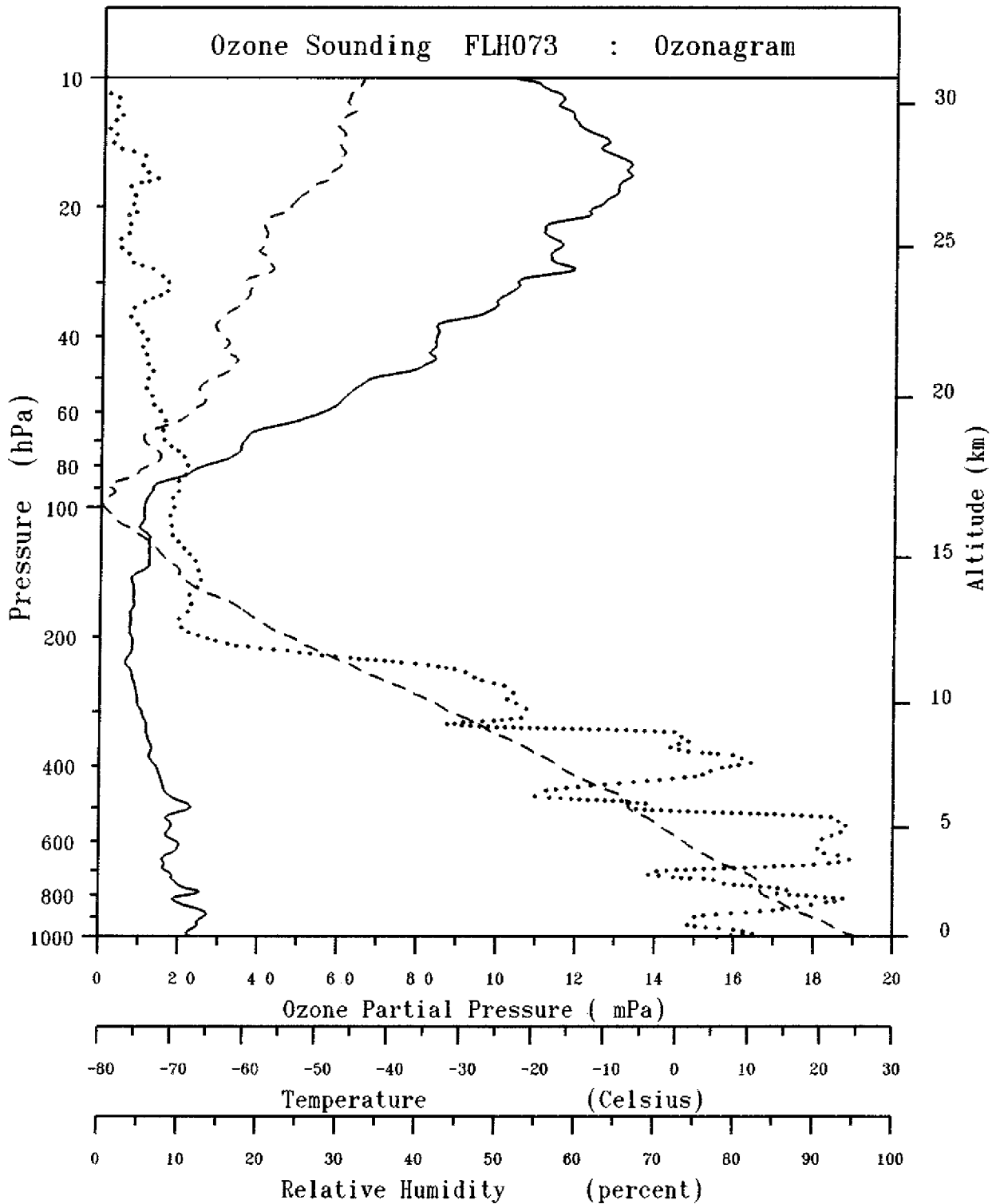
— Ozone
 - - - Temperature
 Relative Humidity



Date 28-09-1988
 Time at launch 10:40 (UTC)
 Location 6:33 N , 30:00 W

— Ozone
 --- Temperature
 Relative Humidity





Date 28-09-1988

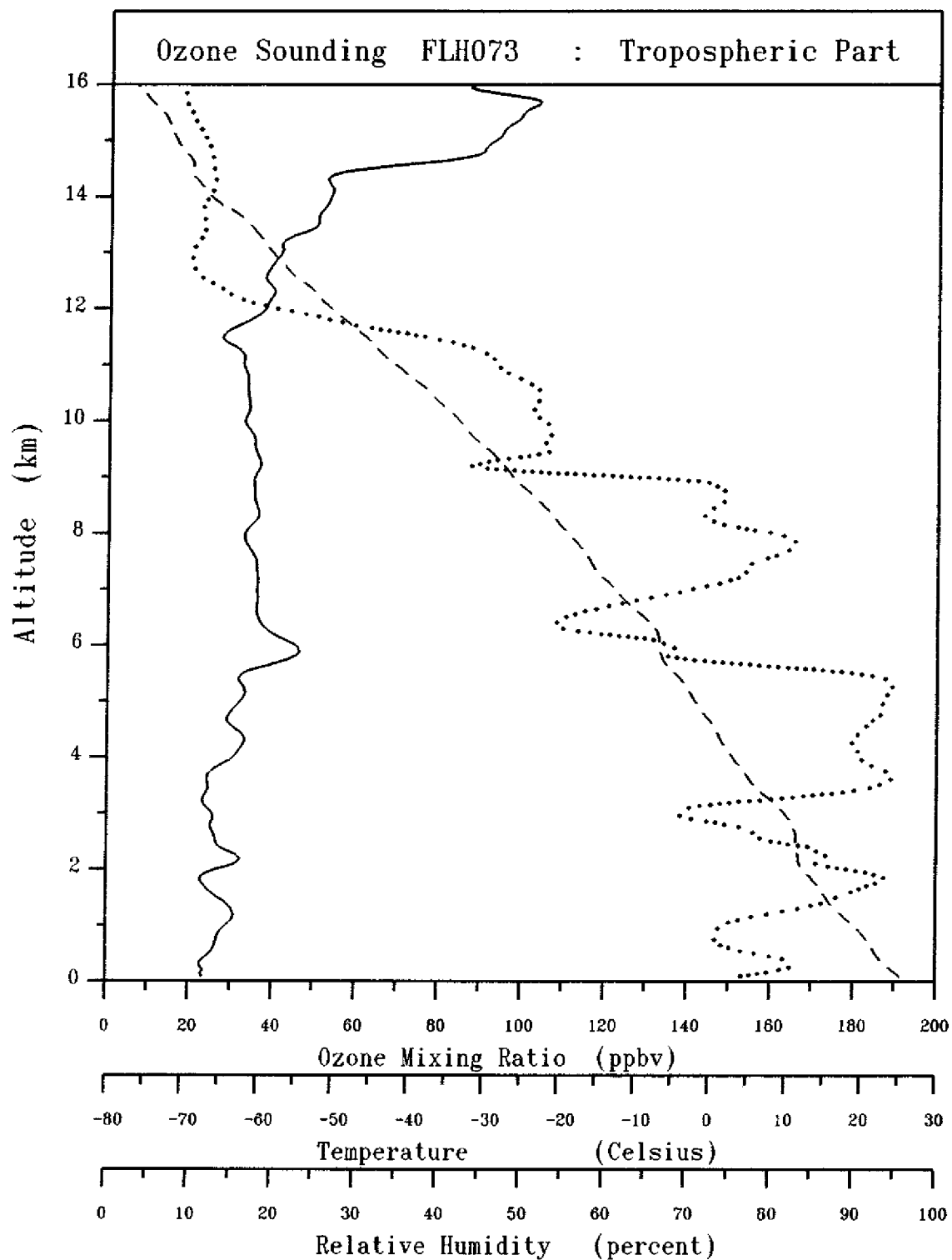
Time at launch 16:30 (UTC)

Location 5:12 N , 30:00 W

— Ozone

- - - Temperature

..... Relative Humidity



Date 28-09-1988

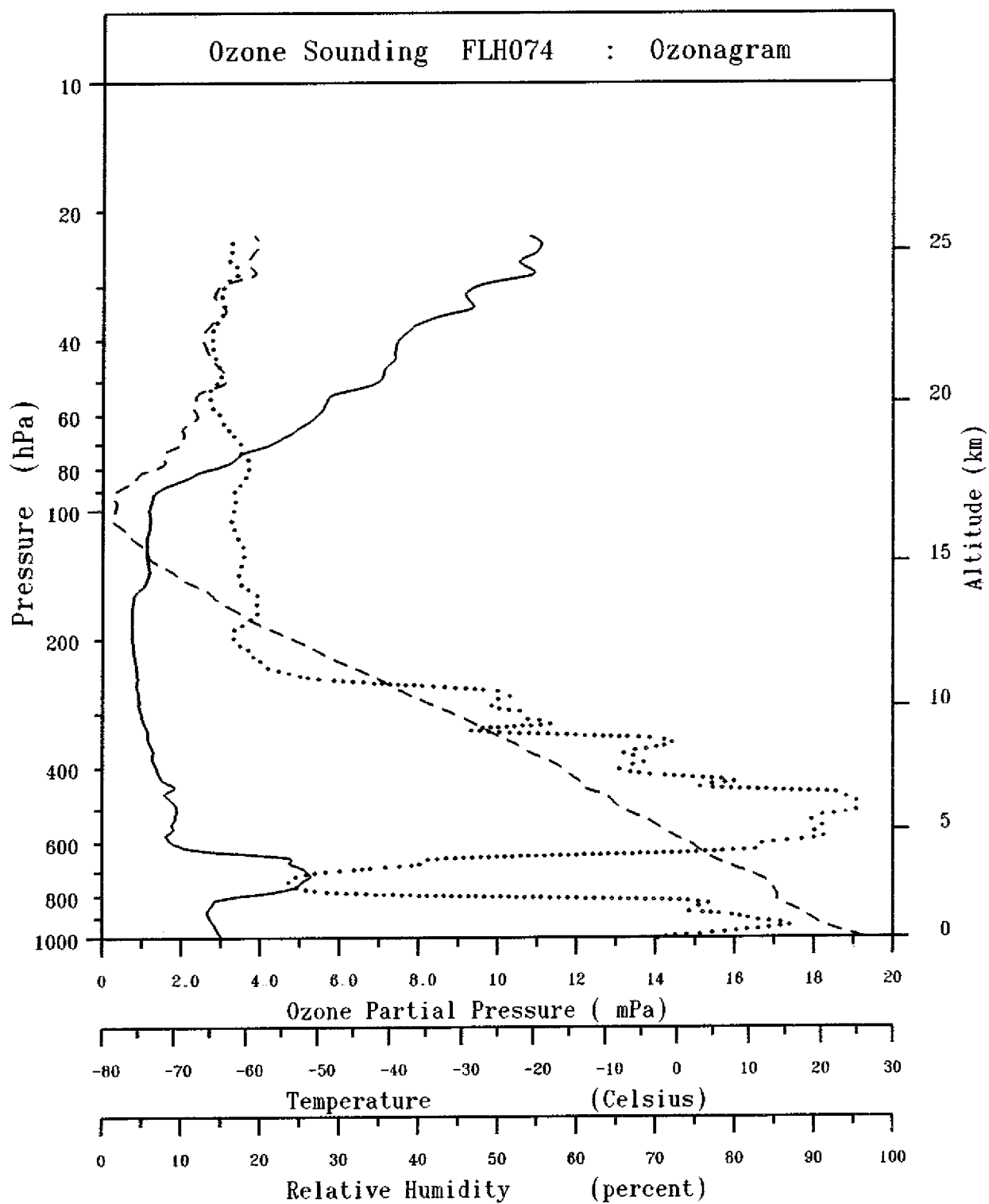
Time at launch 16:30 (UTC)

Location 5:12 N , 30:00 W

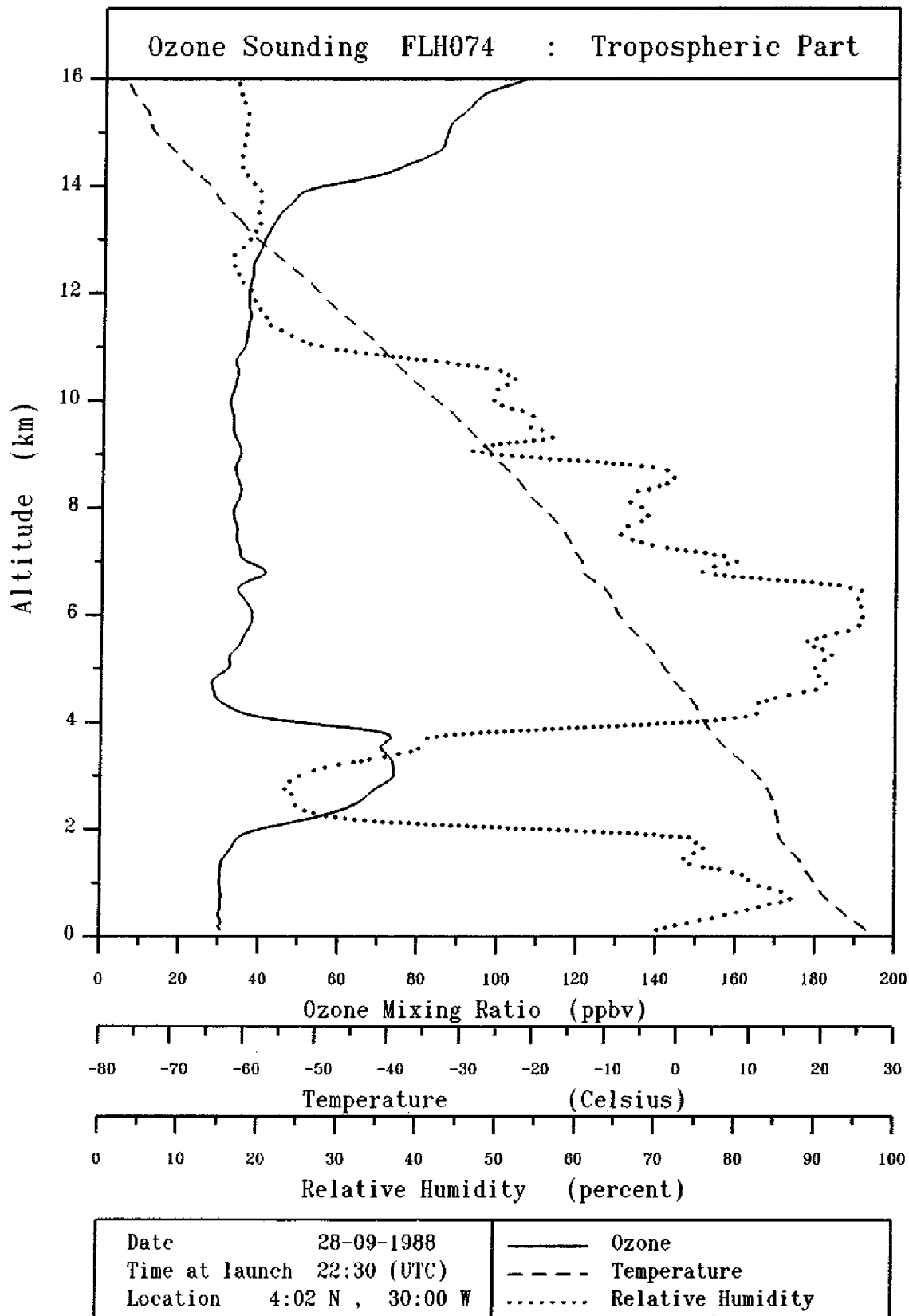
——— Ozone

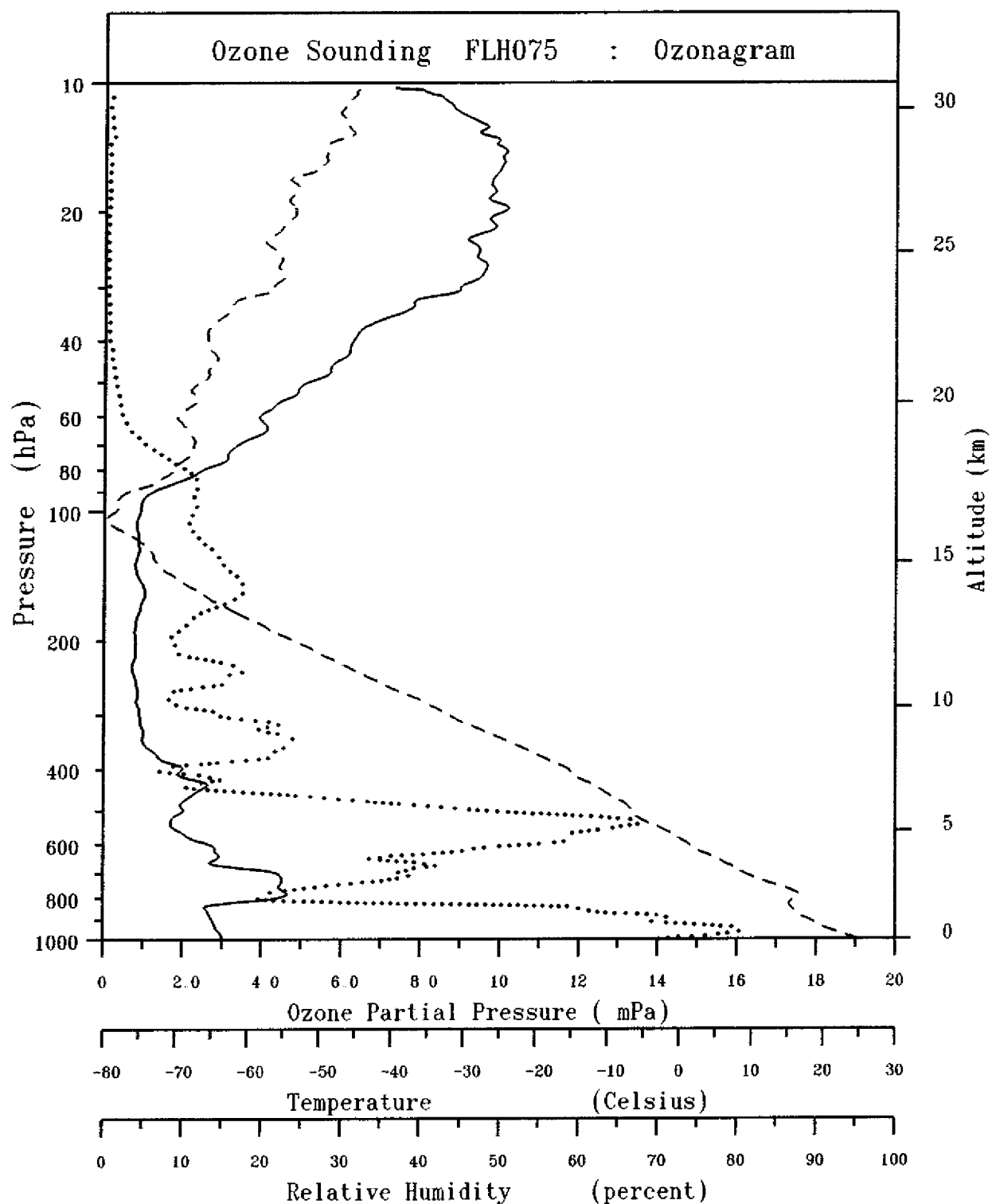
- - - - Temperature

..... Relative Humidity

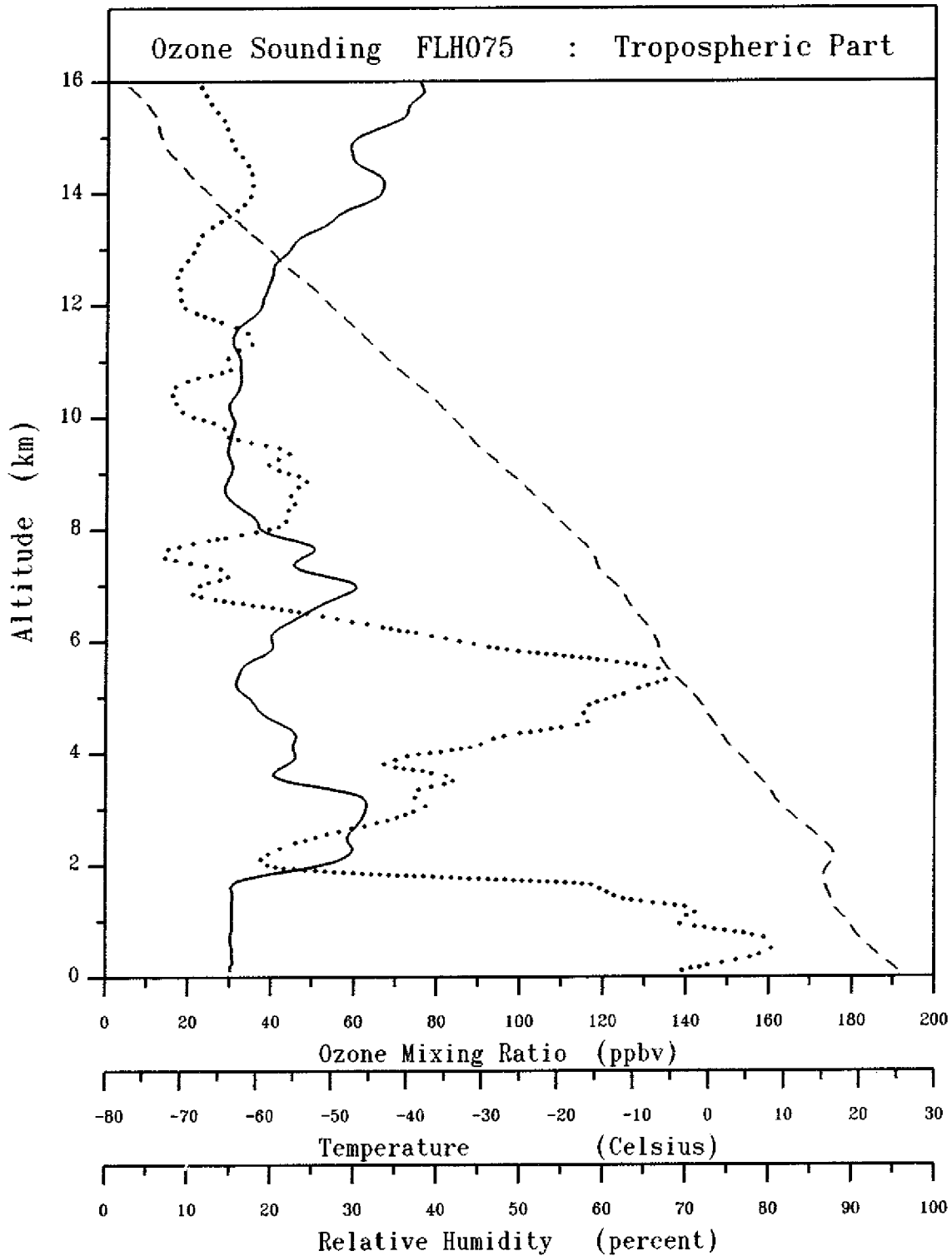


Date	28-09-1988	—	Ozone
Time at launch	22:30 (UTC)	- - -	Temperature
Location	4:02 N , 30:00 W	.....	Relative Humidity





Date	29-09-1988	—	Ozone
Time at launch	11:50 (UTC)	- - -	Temperature
Location	1:12 N , 30:00 W	.....	Relative Humidity



Date 29-09-1988

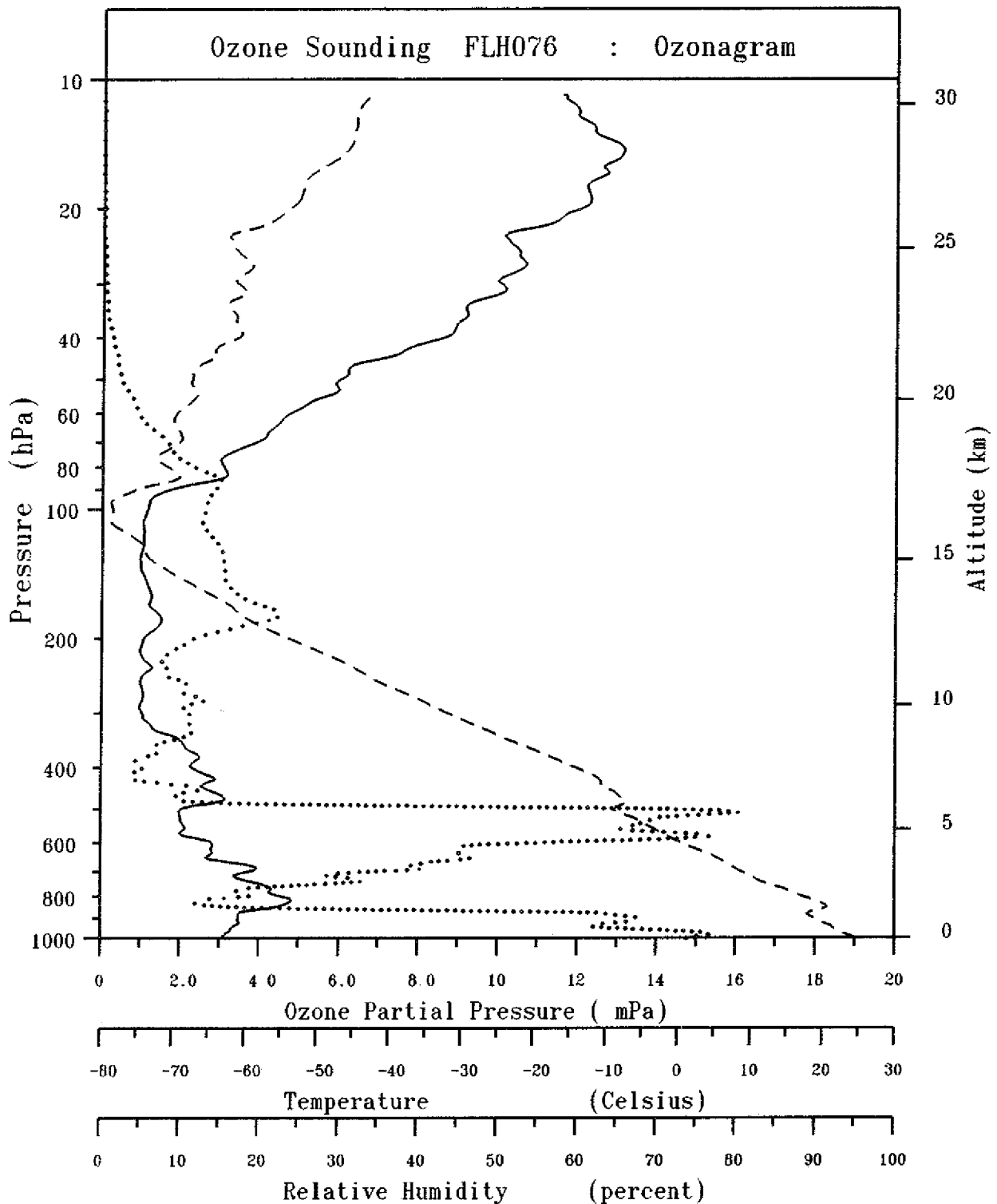
Time at launch 11:50 (UTC)

Location 1:12 N , 30:00 W

—— Ozone

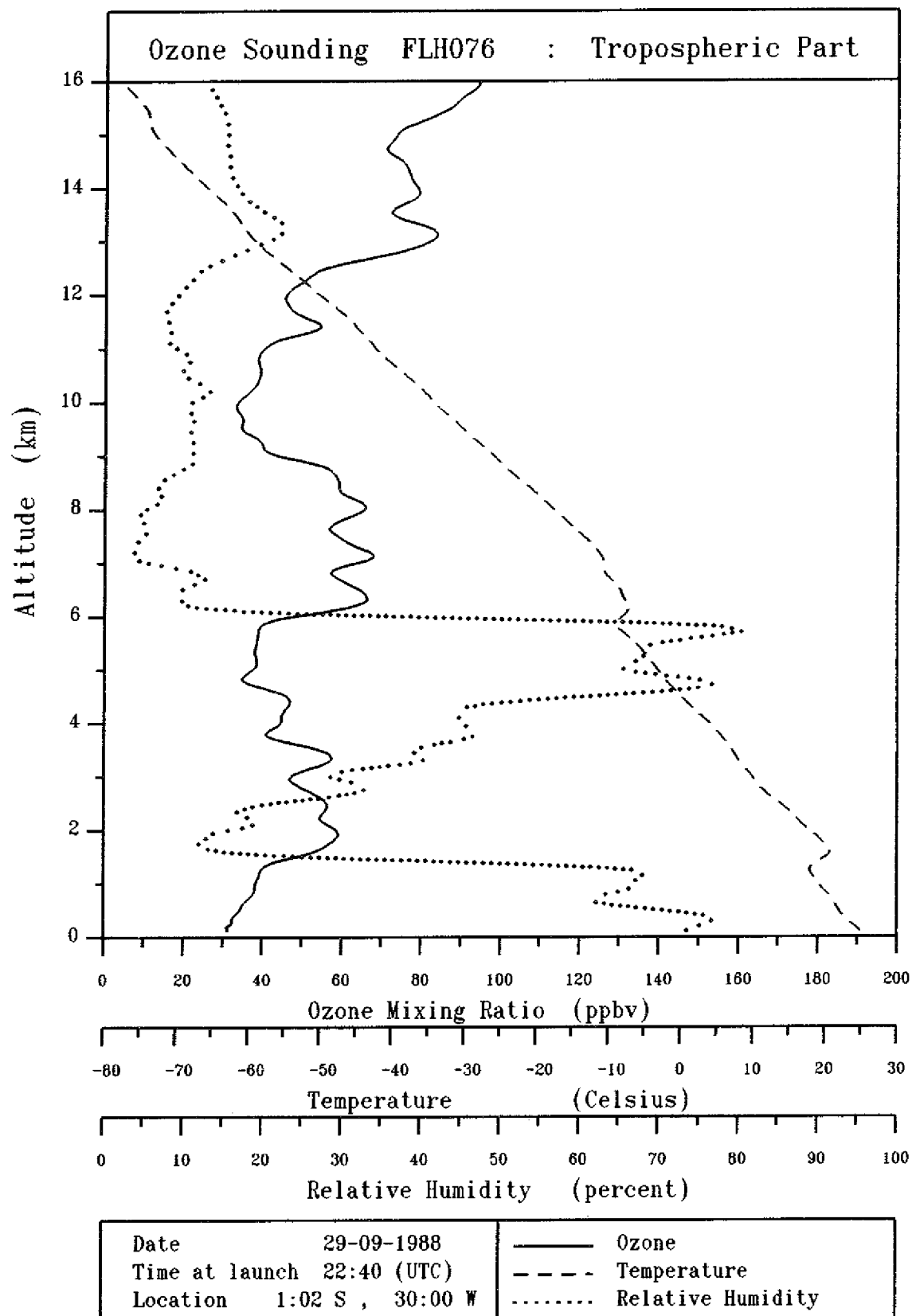
--- Temperature

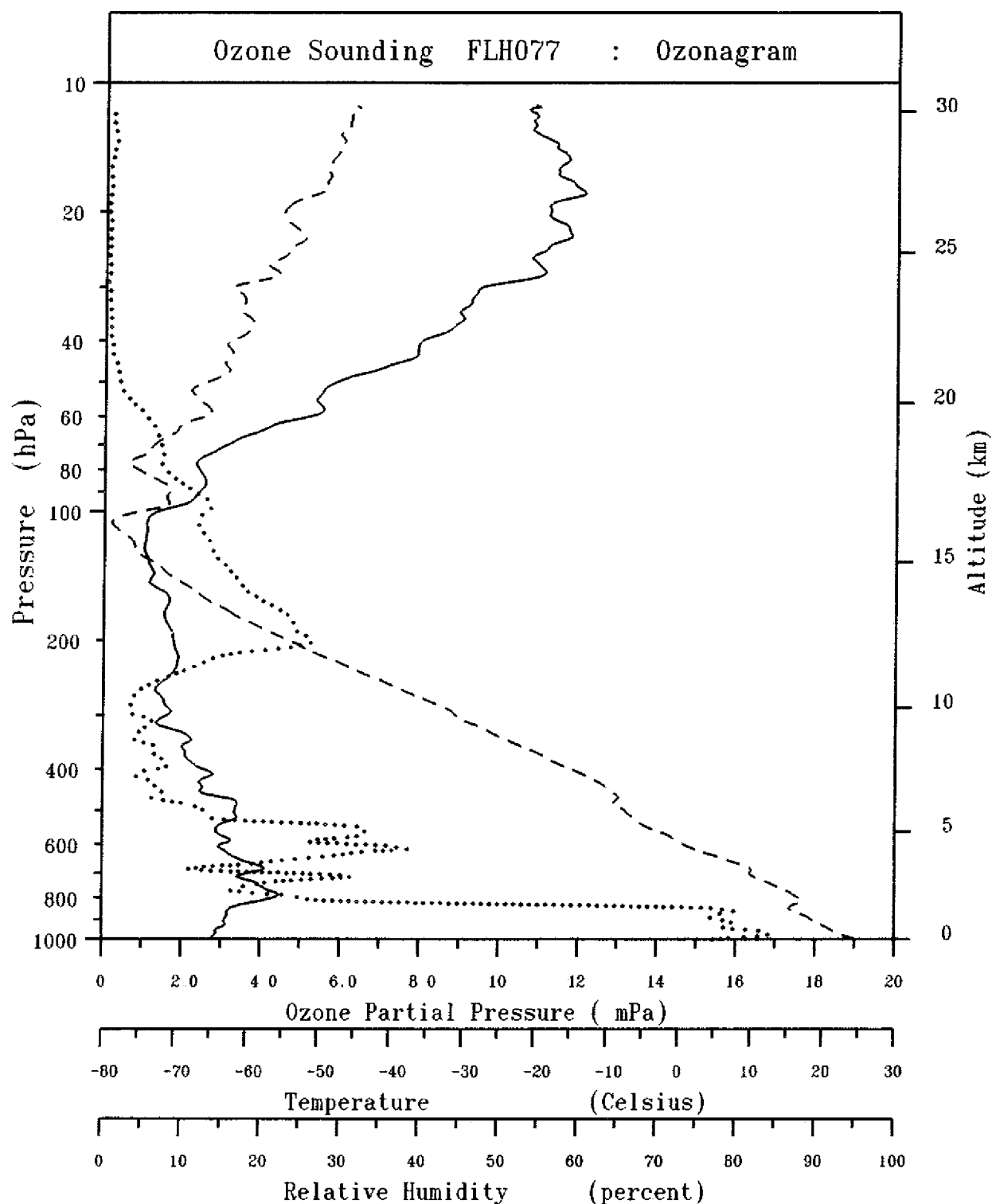
..... Relative Humidity



Date 29-09-1988
 Time at launch 22:40 (UTC)
 Location 1:02 S , 30:00 W

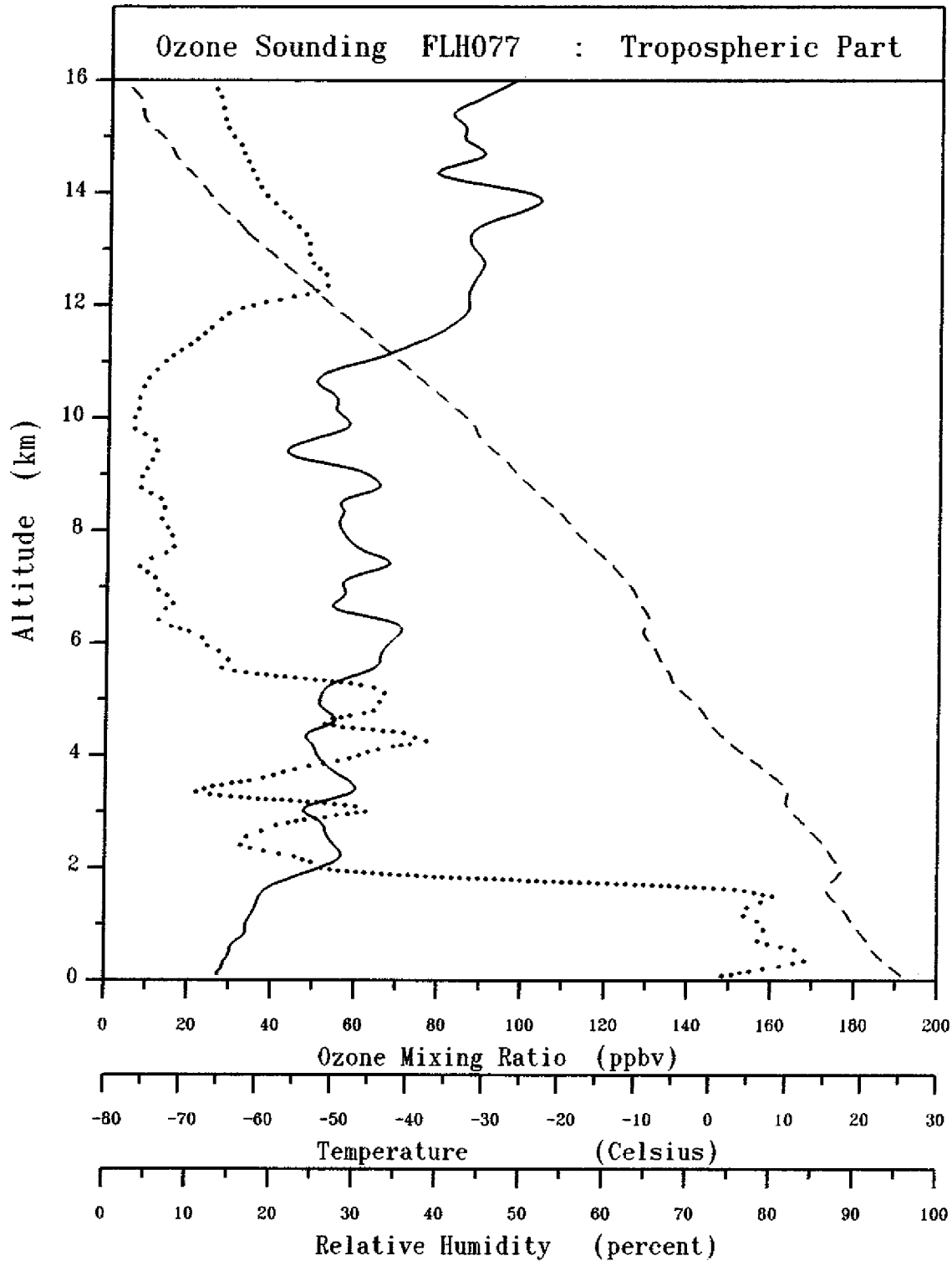
— Ozone
 --- Temperature
 Relative Humidity



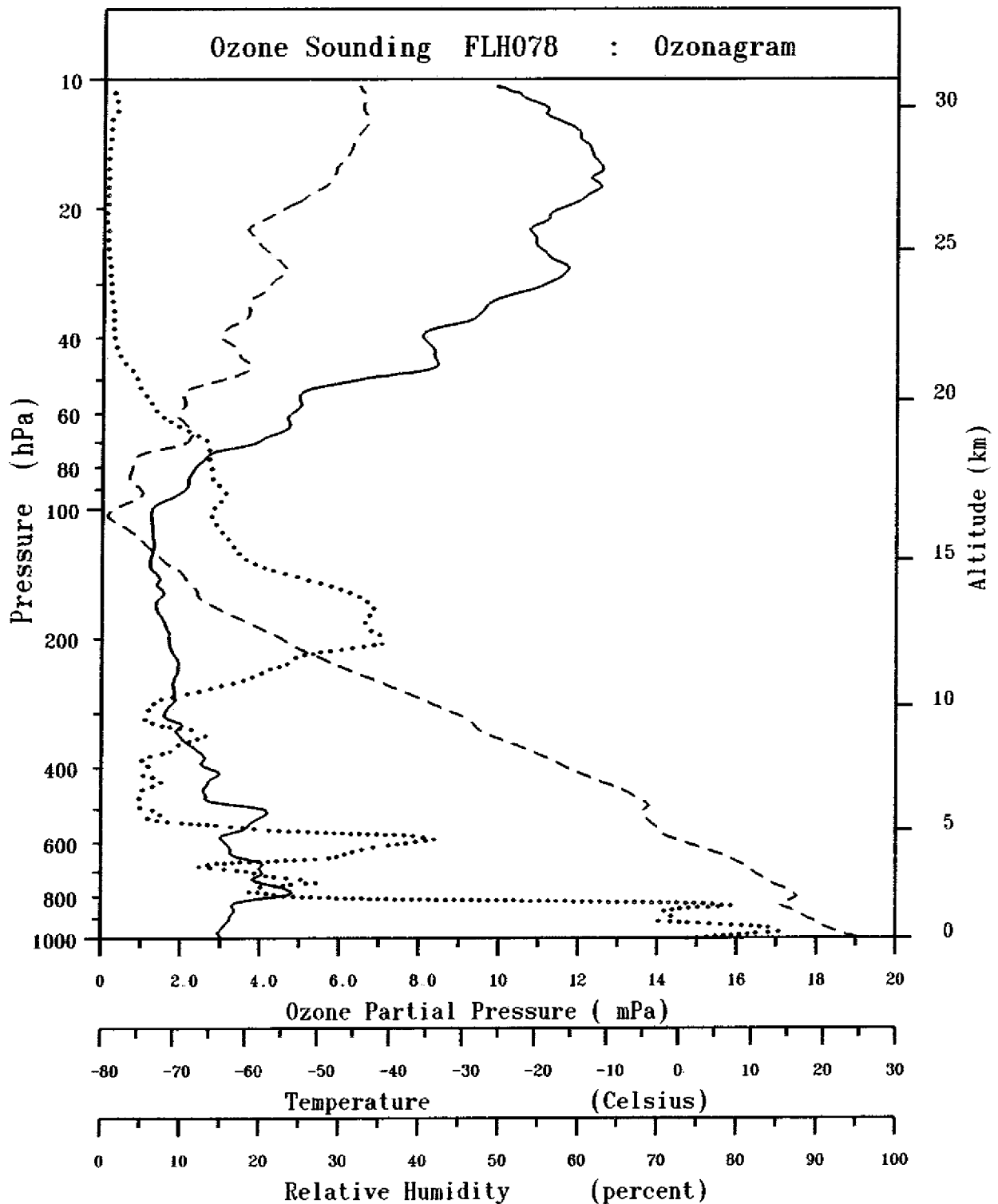


Date 30-09-1988
 Time at launch 11:45 (UTC)
 Location 3:51 S , 30:00 W

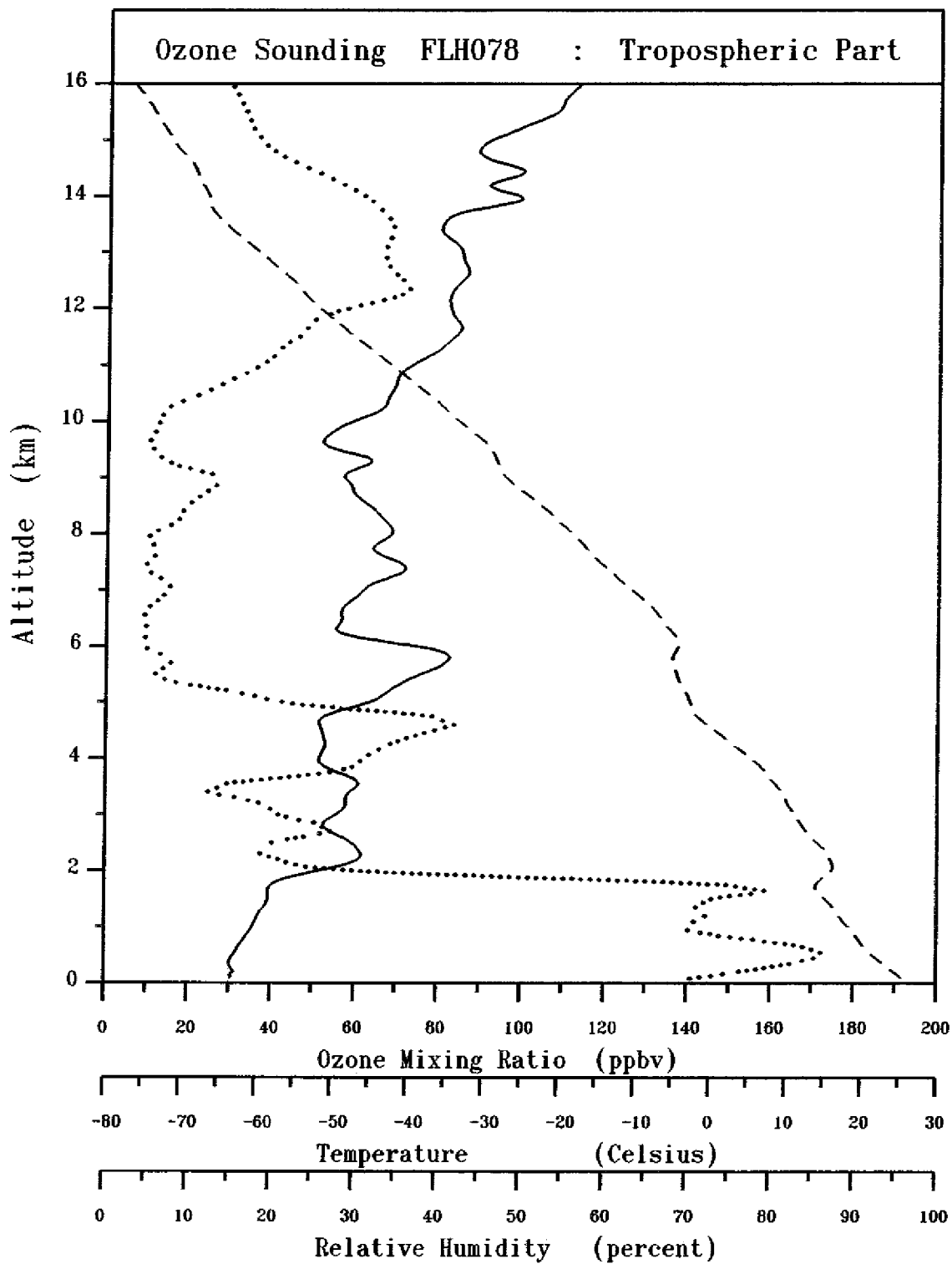
— Ozone
 - - - Temperature
 Relative Humidity



Date	30-09-1988	—	Ozone
Time at launch	11:45 (UTC)	- - -	Temperature
Location	3:51 S , 30:00 W	.....	Relative Humidity

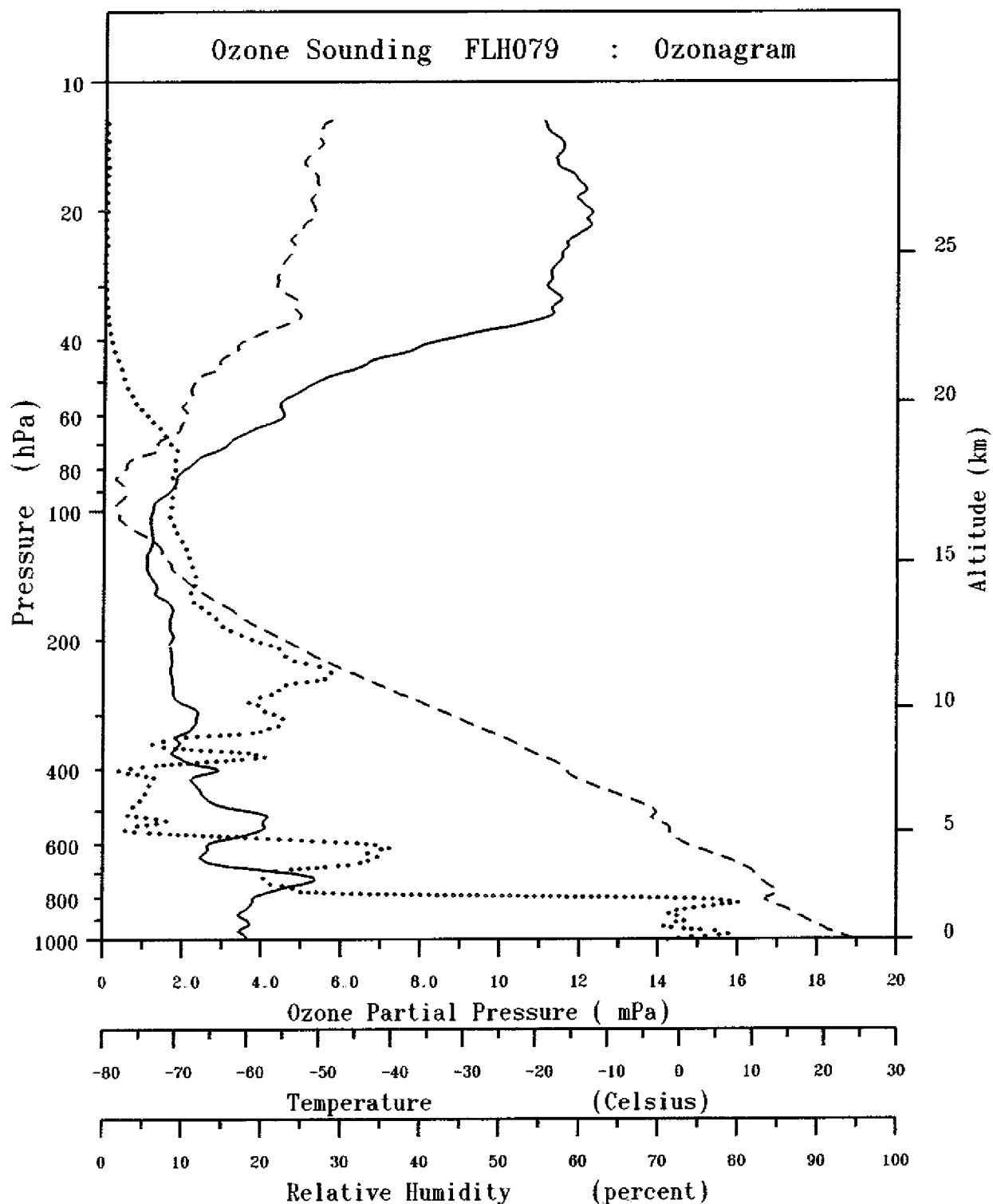


Date	30-09-1988	—	Ozone
Time at launch	23:00 (UTC)	- - -	Temperature
Location	6:18 S , 30:00 W	.....	Relative Humidity



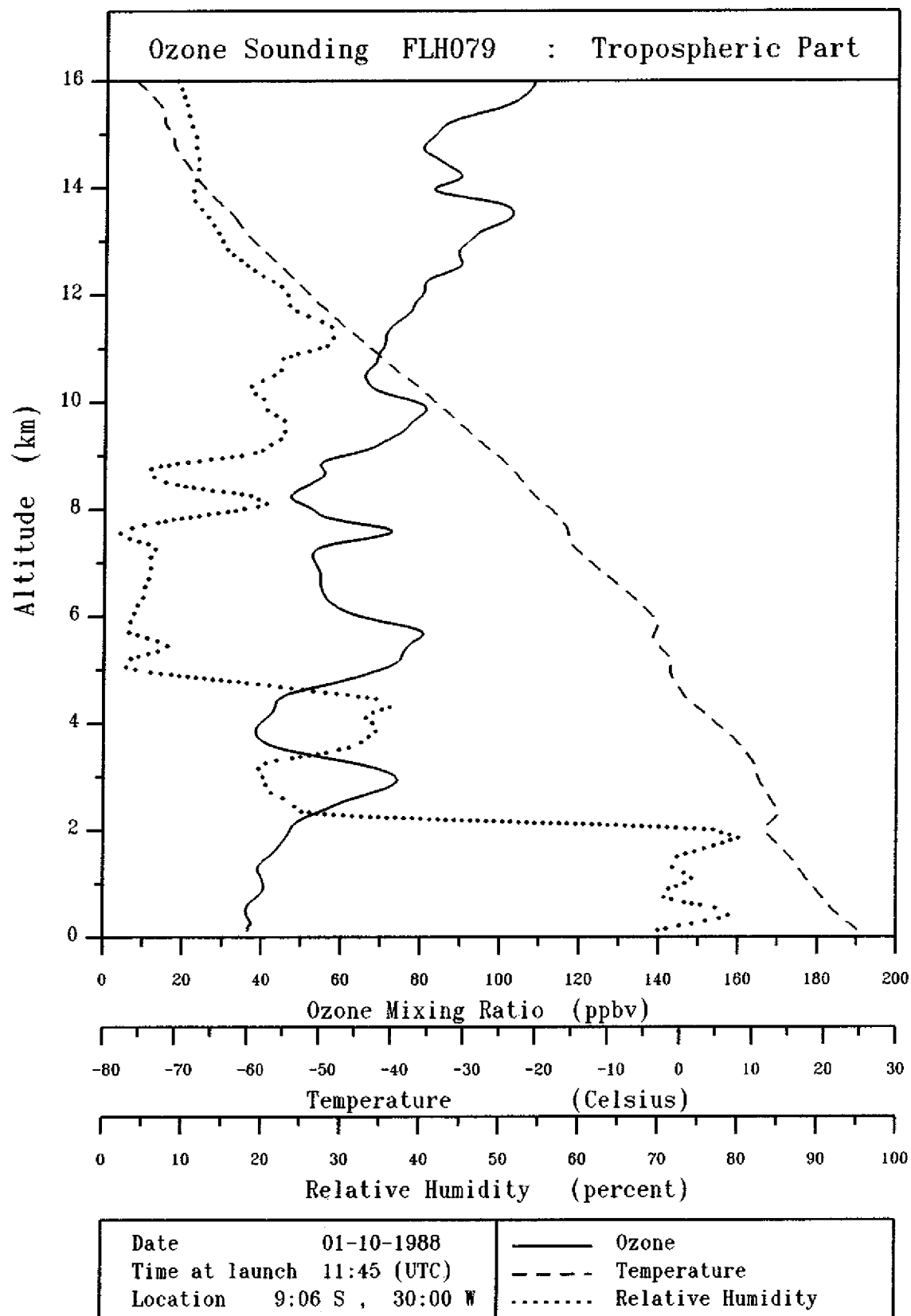
Date 30-09-1988
 Time at launch 23:00 (UTC)
 Location 6:18 S , 30:00 W

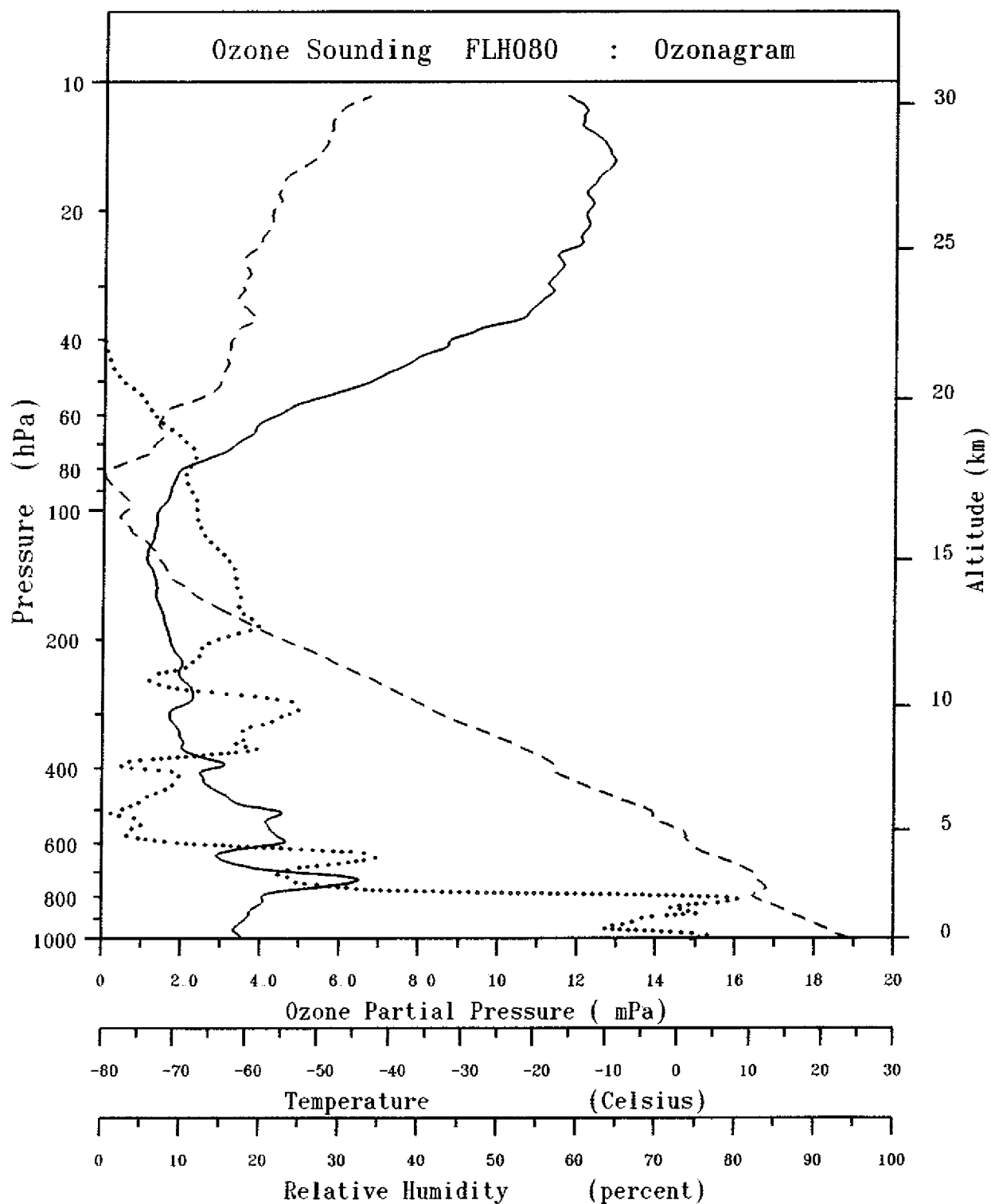
— Ozone
 --- Temperature
 Relative Humidity



Date 01-10-1988
 Time at launch 11:45 (UTC)
 Location 9:06 S , 30:00 W

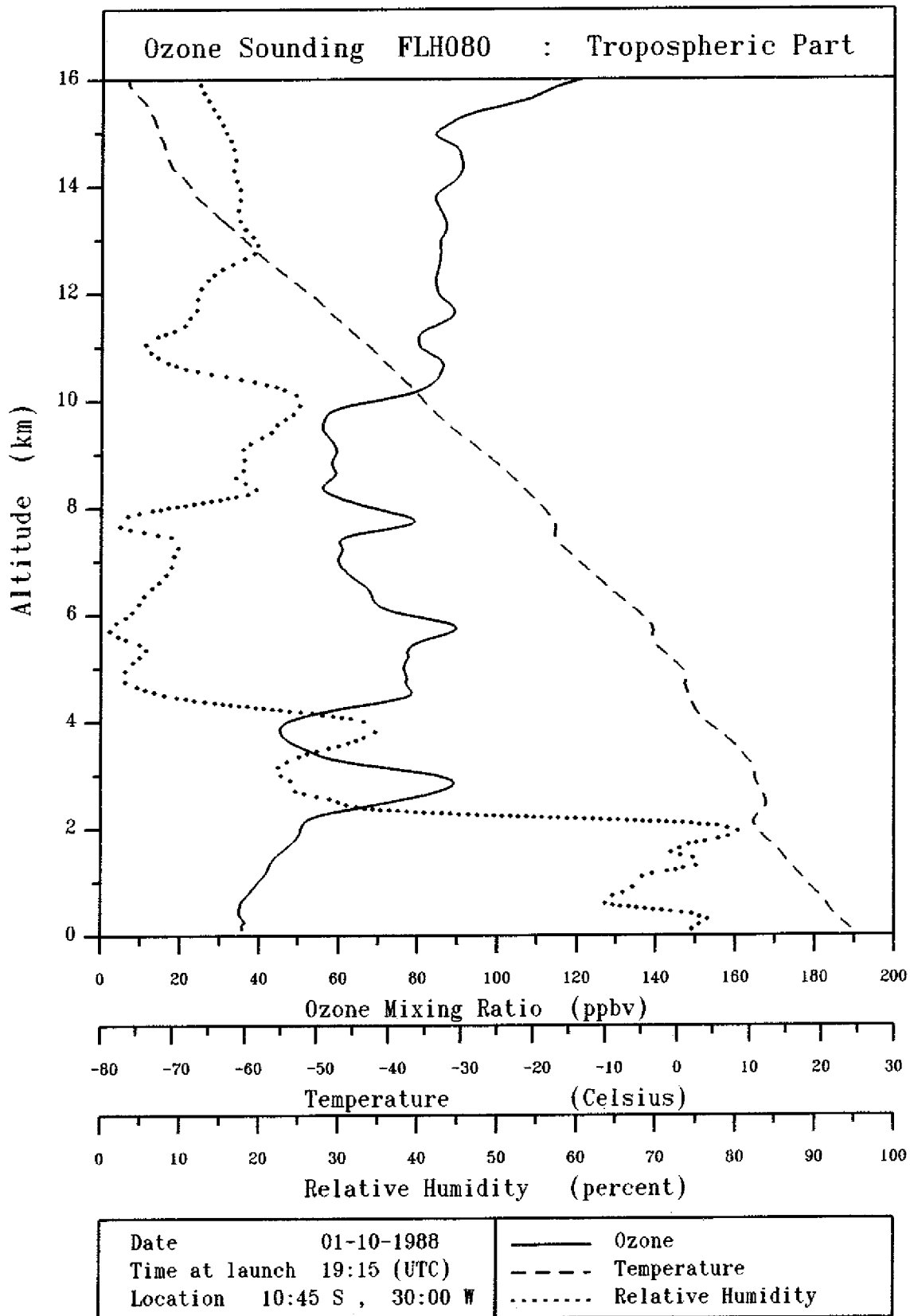
— Ozone
 --- Temperature
 Relative Humidity

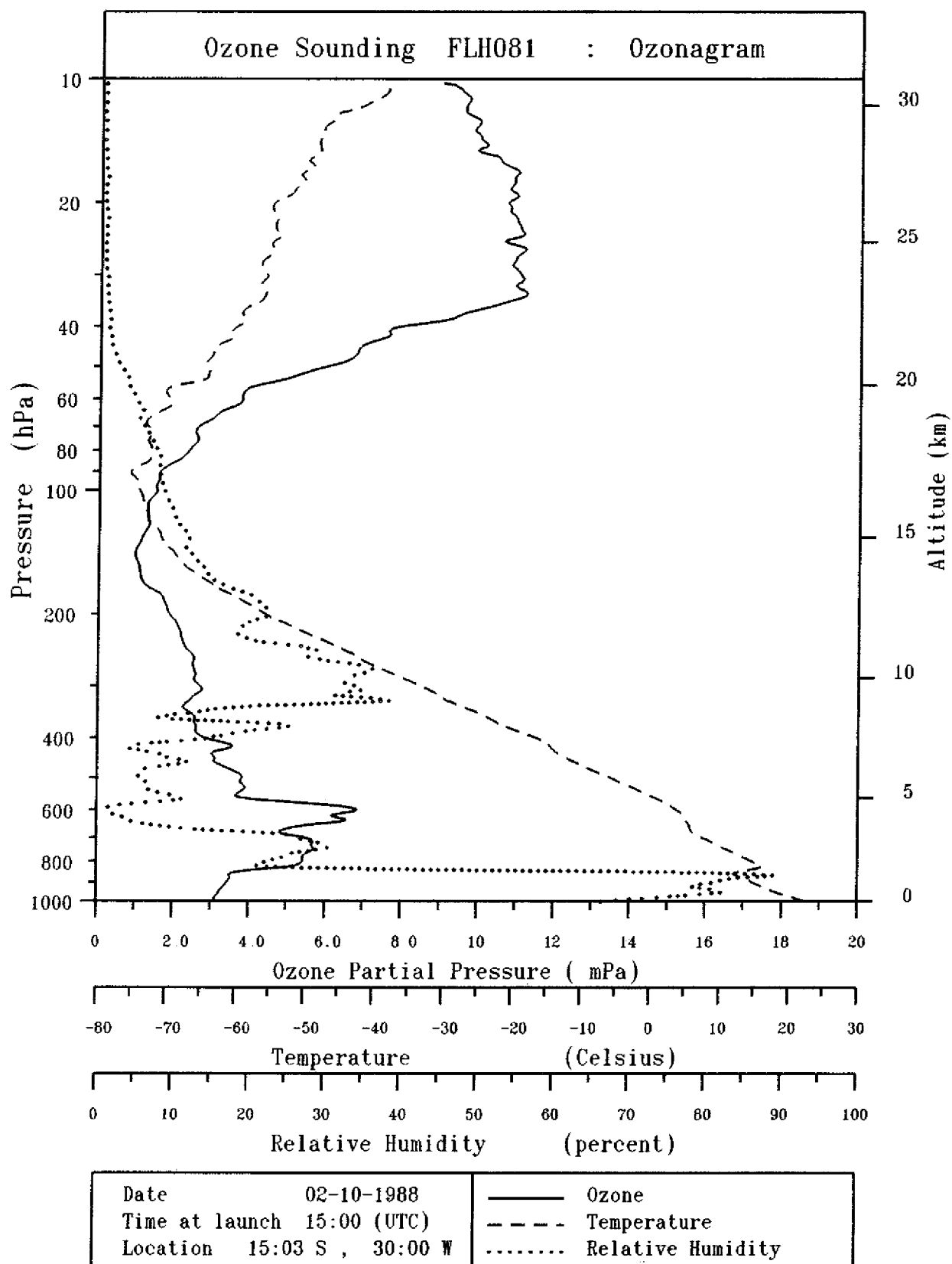


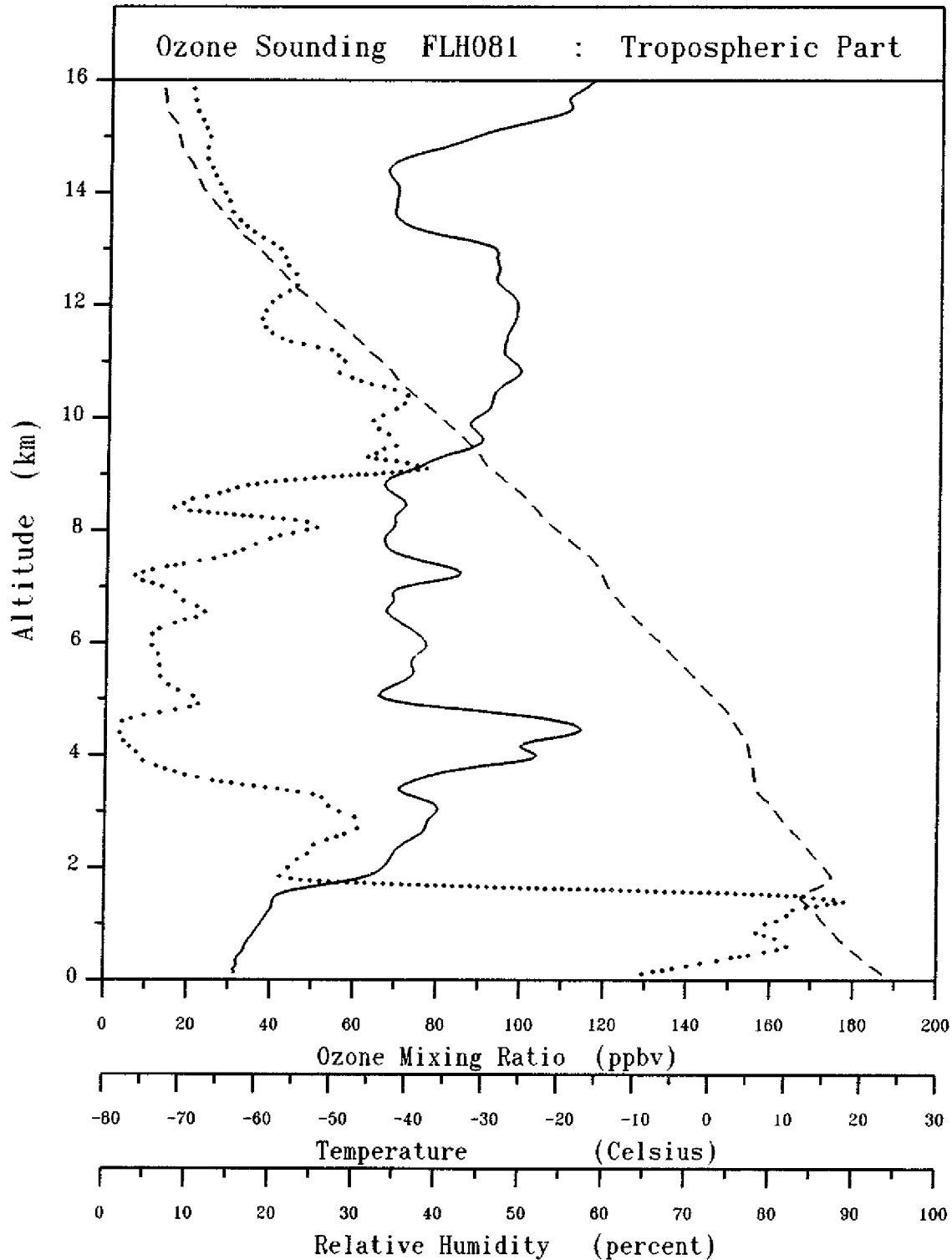


Date 01-10-1988
 Time at launch 19:15 (UTC)
 Location 10:45 S , 30:00 W

— Ozone
 --- Temperature
 Relative Humidity

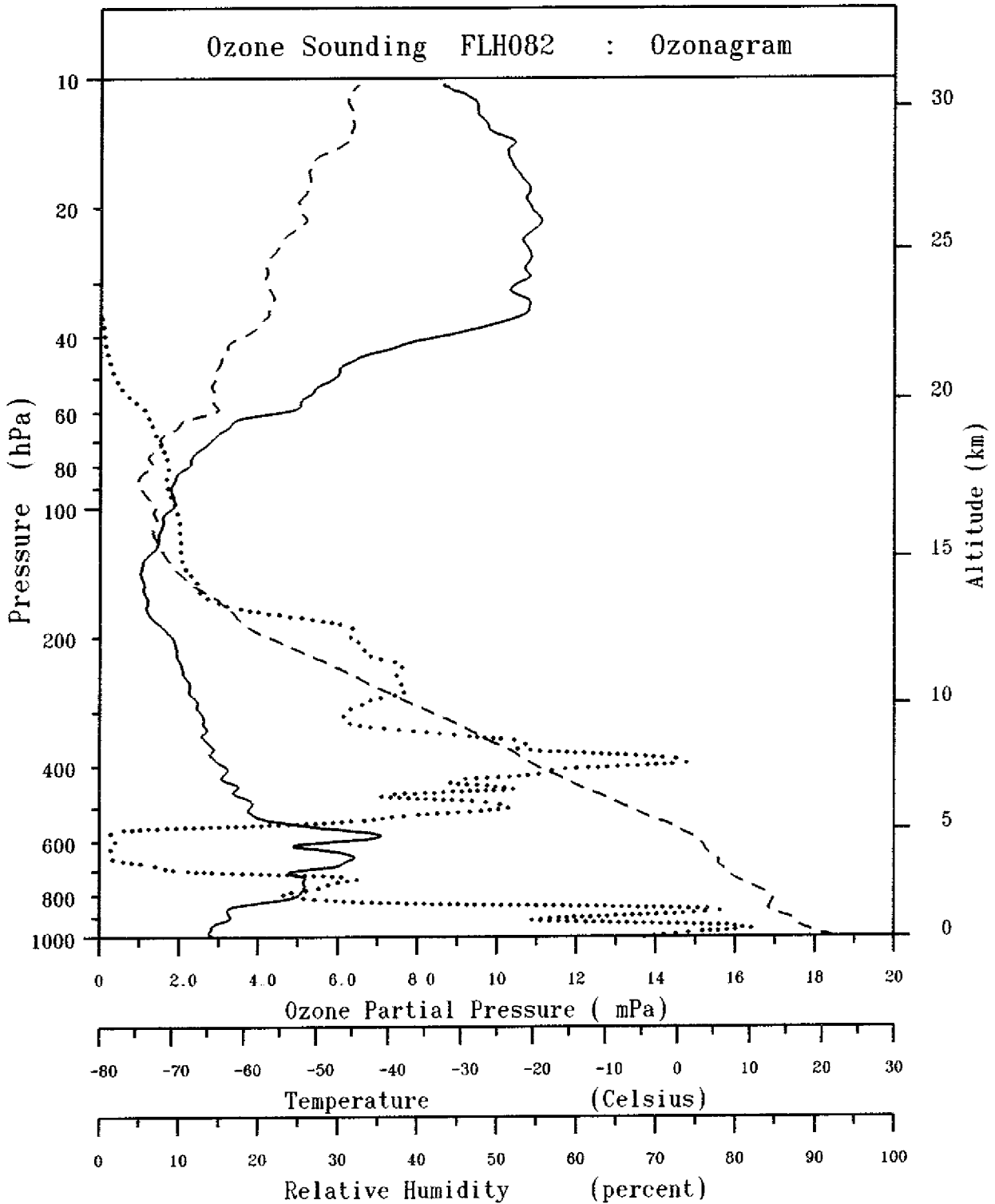




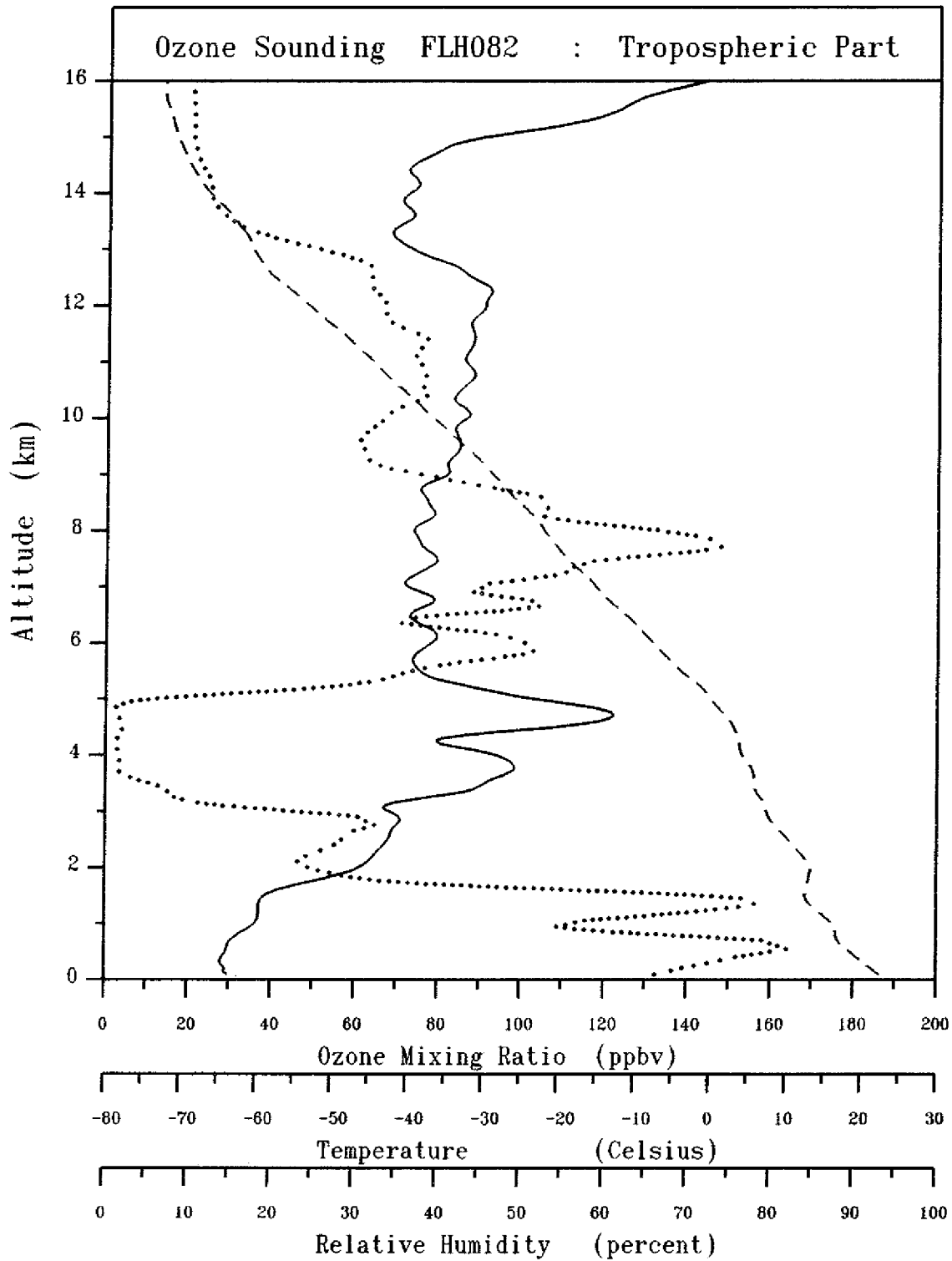


Date 02-10-1988
 Time at launch 15:00 (UTC)
 Location 15:03 S , 30:00 W

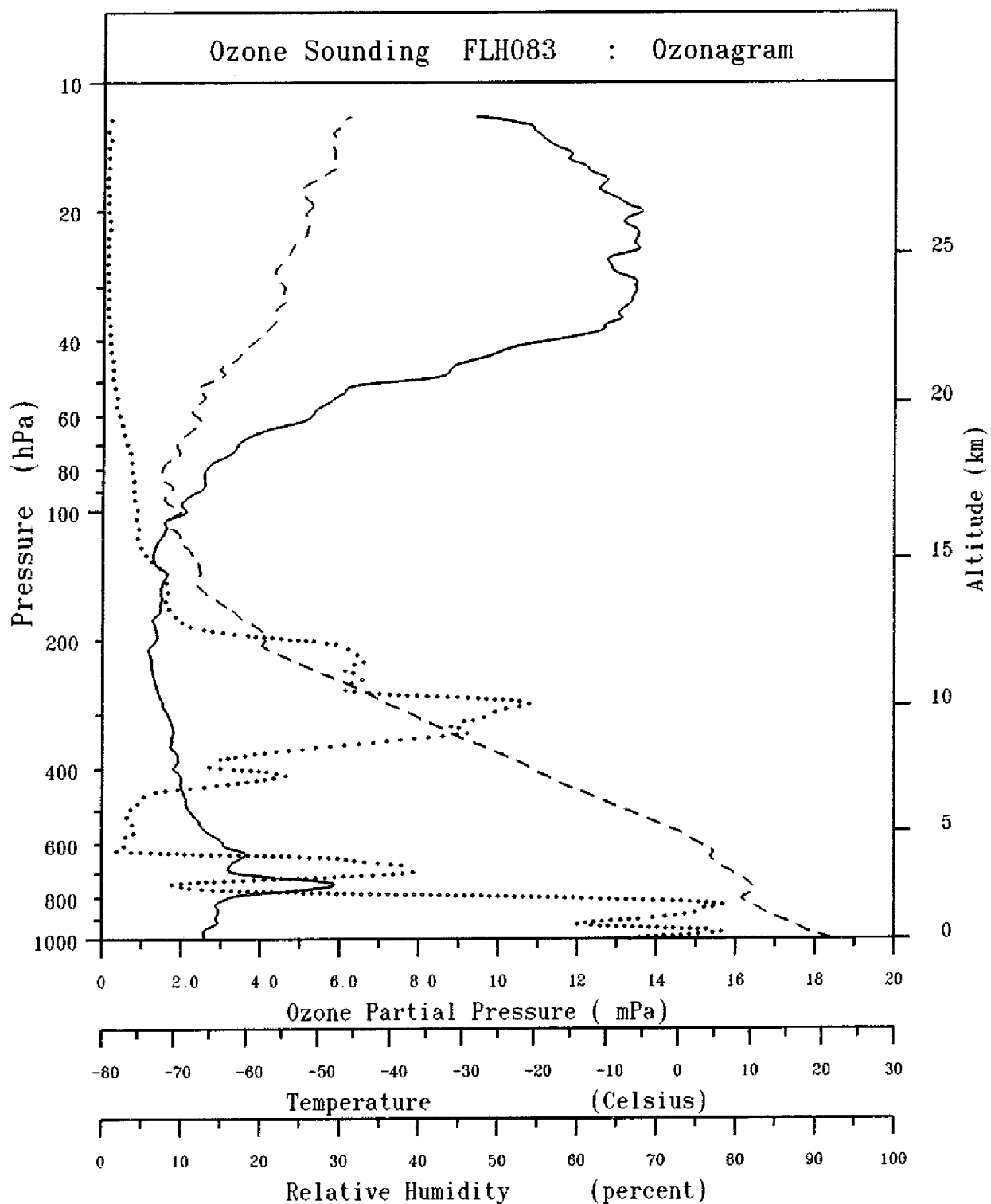
— Ozone
 --- Temperature
 Relative Humidity



Date	02-10-1988	—	Ozone
Time at launch	22:30 (UTC)	- - -	Temperature
Location	16:42 S , 30:00 W	.....	Relative Humidity

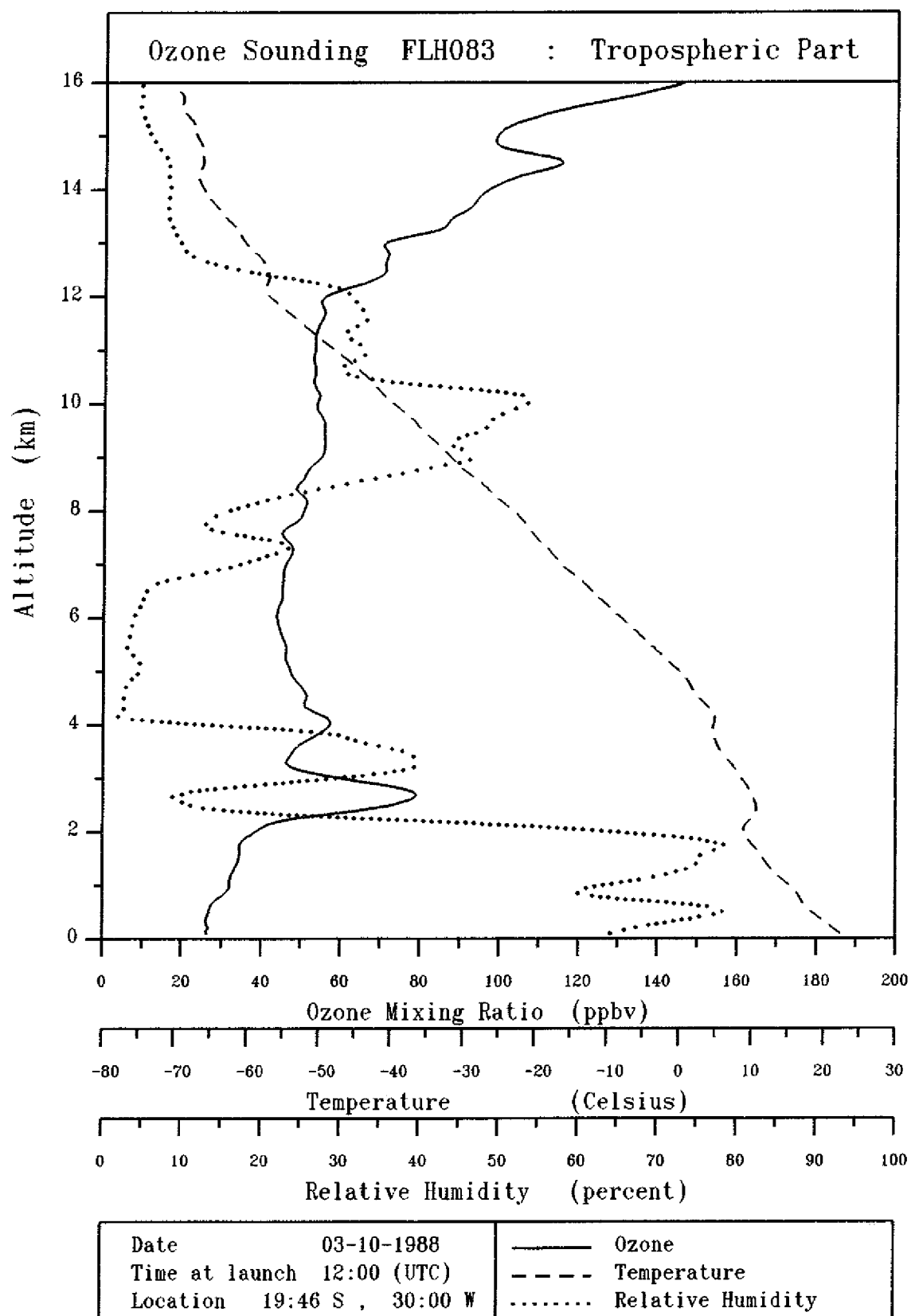


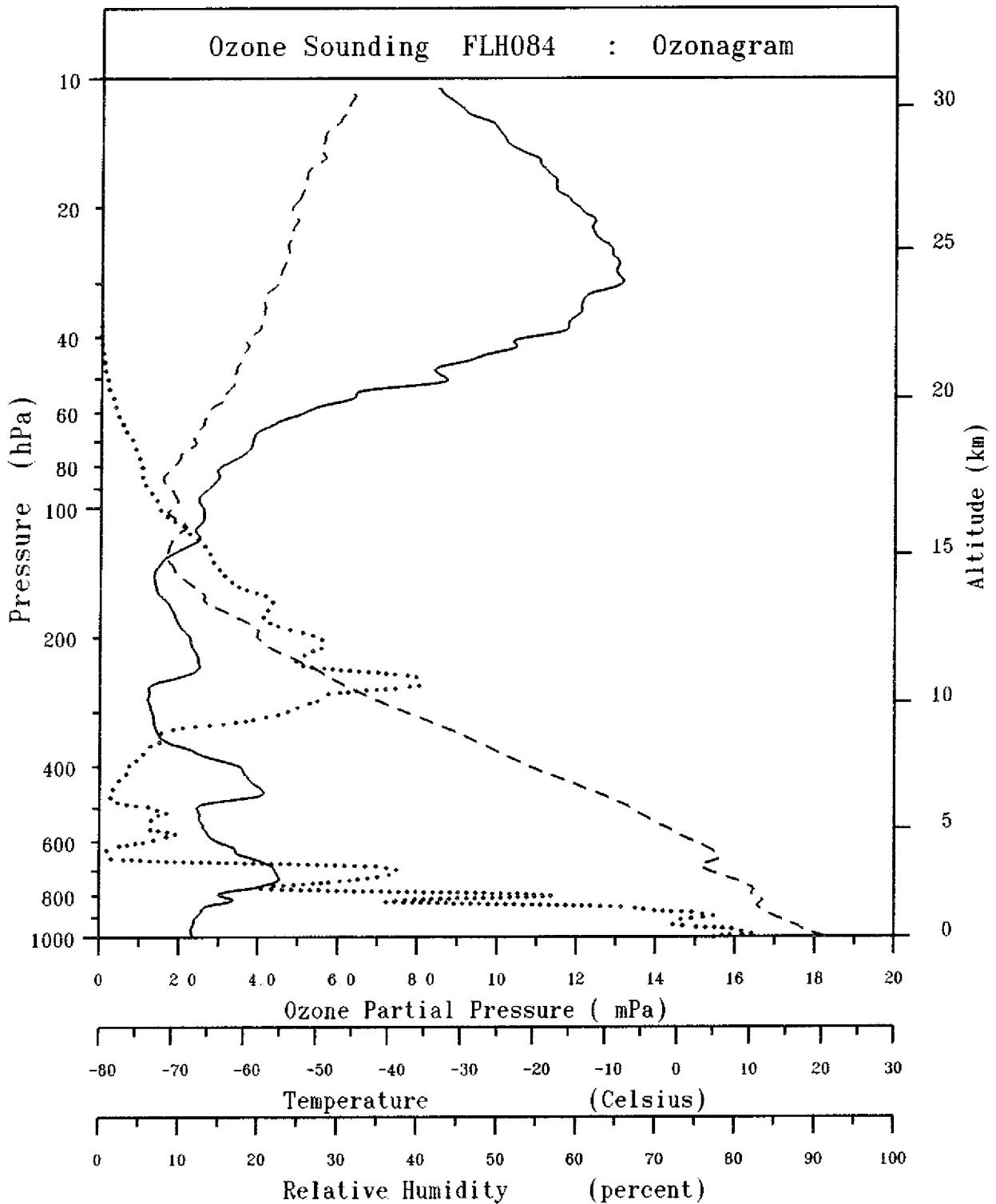
Date	02-10-1988	—	Ozone
Time at launch	22:30 (UTC)	- - -	Temperature
Location	16:42 S , 30:00 W	.....	Relative Humidity



Date 03-10-1988
 Time at launch 12:00 (UTC)
 Location 19:46 S , 30:00 W

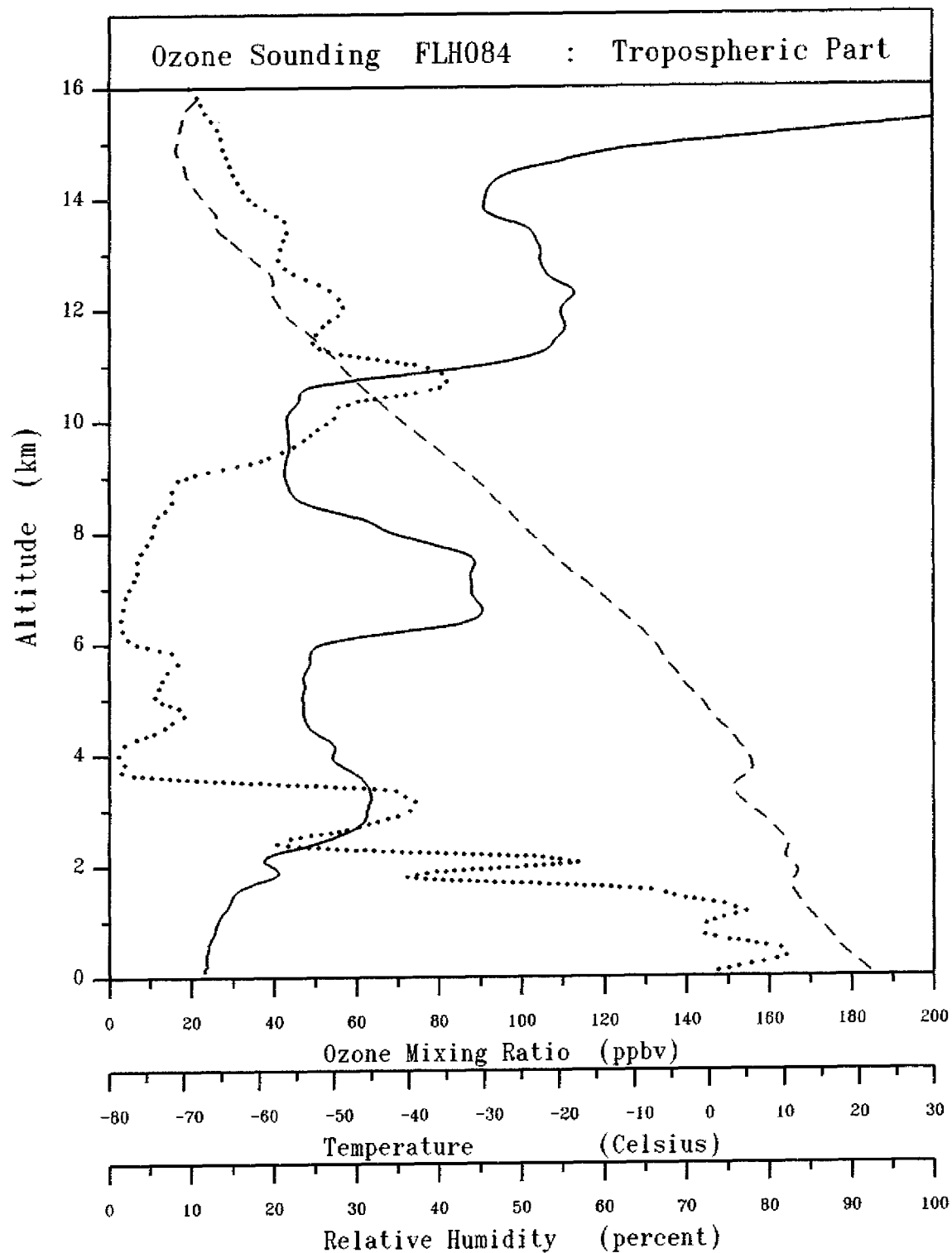
— Ozone
 --- Temperature
 Relative Humidity



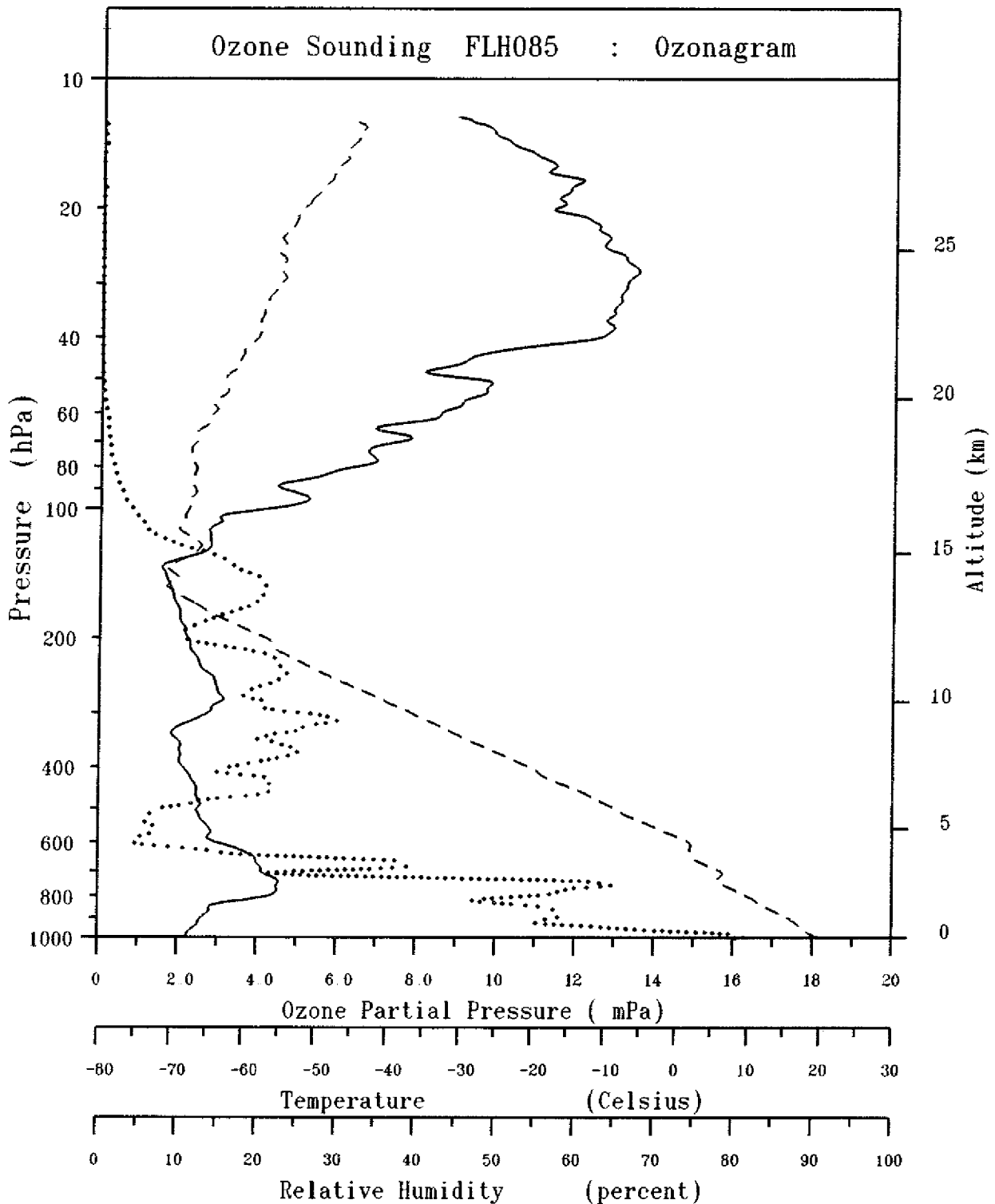


Date 03-10-1988
 Time at launch 22:30 (UTC)
 Location 22:06 S , 30:00 W

— Ozone
 - - - Temperature
 Relative Humidity

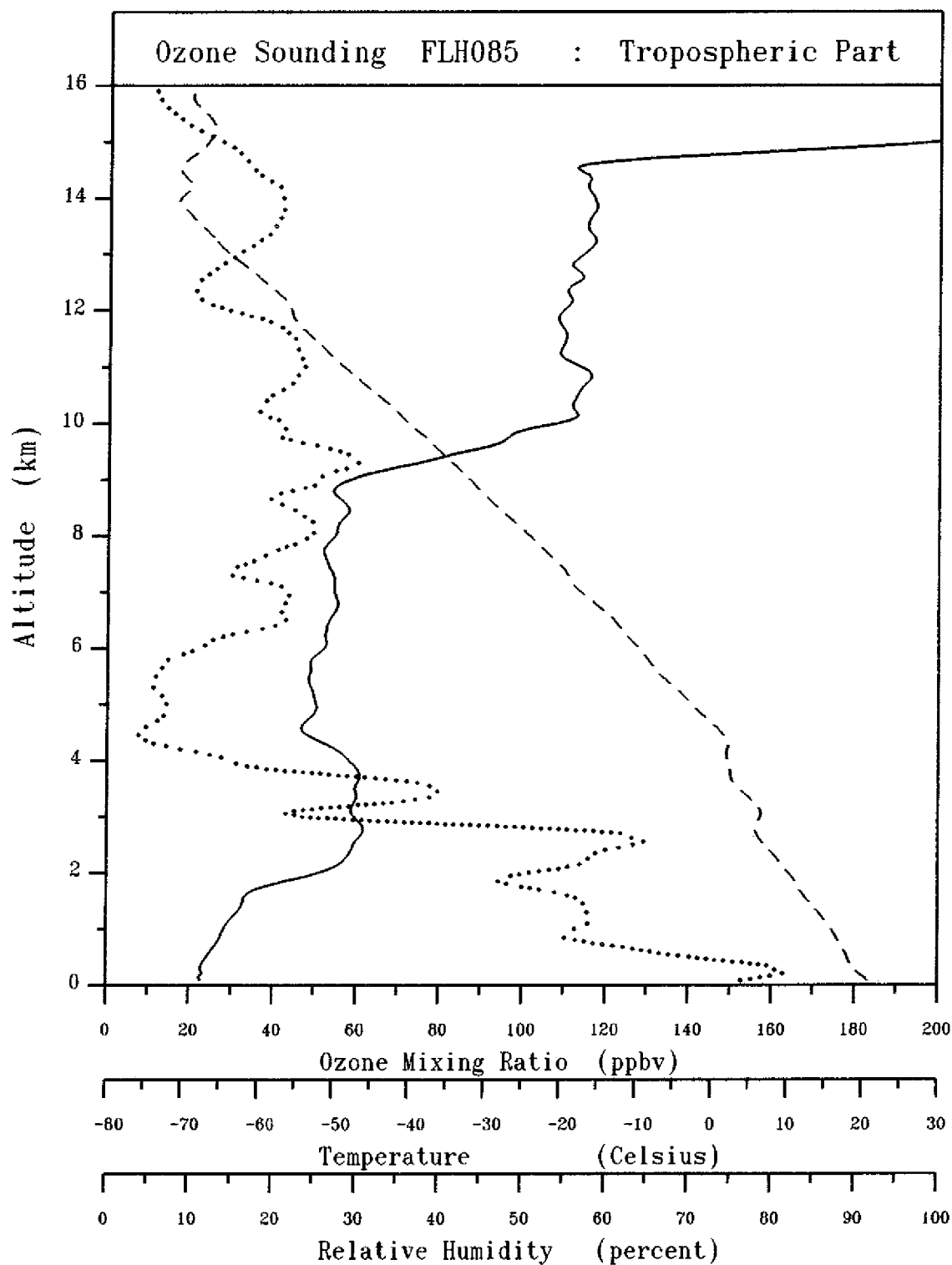


Date	03-10-1988	—	Ozone
Time at launch	22:30 (UTC)	- - - -	Temperature
Location	22:06 S , 30:00 W	.....	Relative Humidity



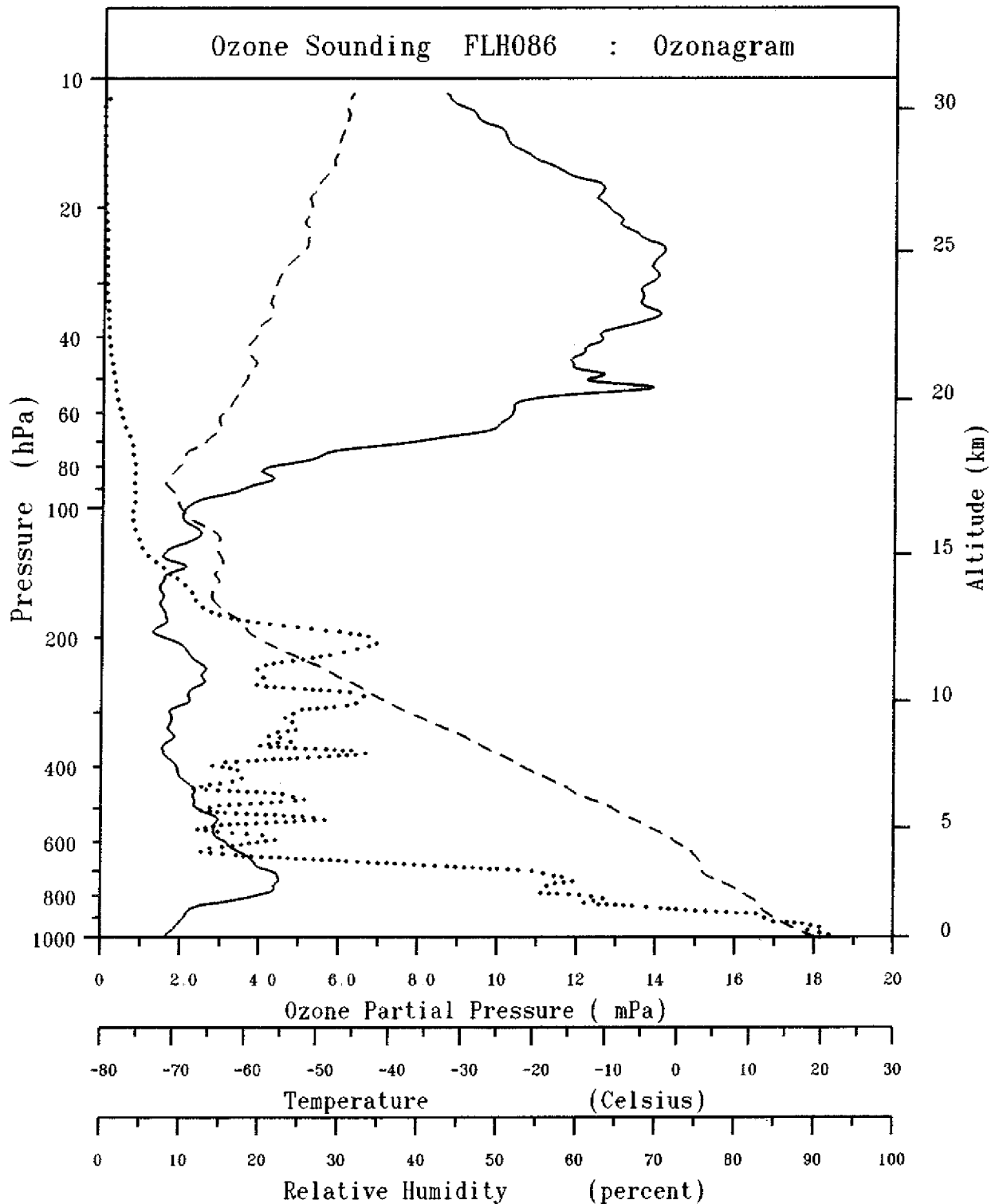
Date 04-10-1988
 Time at launch 12:25 (UTC)
 Location 25:18 S , 30:00 W

— Ozone
 --- Temperature
 Relative Humidity



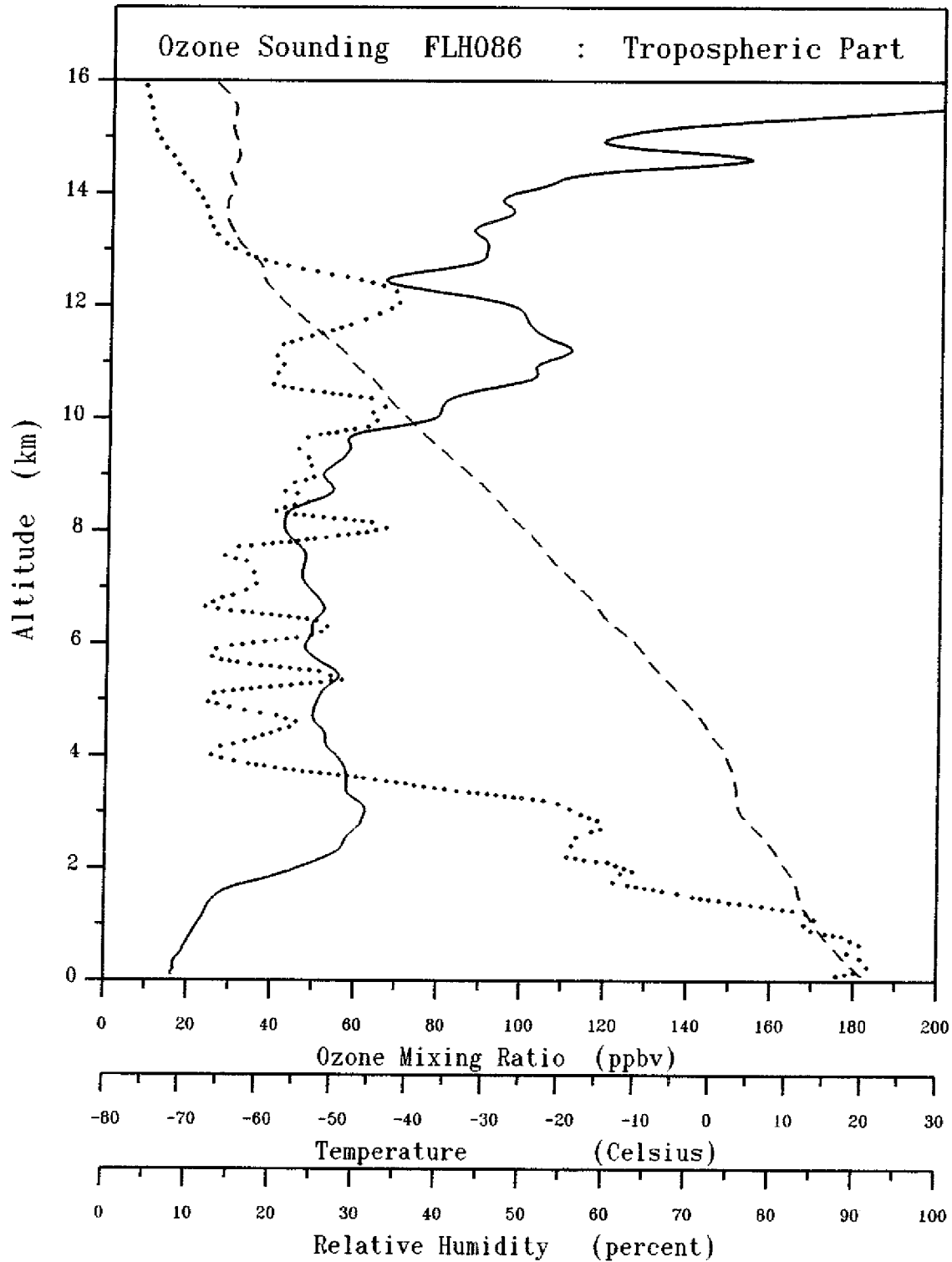
Date 04-10-1988
 Time at launch 12:25 (UTC)
 Location 25:18 S , 30:00 W

— Ozone
 - - - Temperature
 Relative Humidity



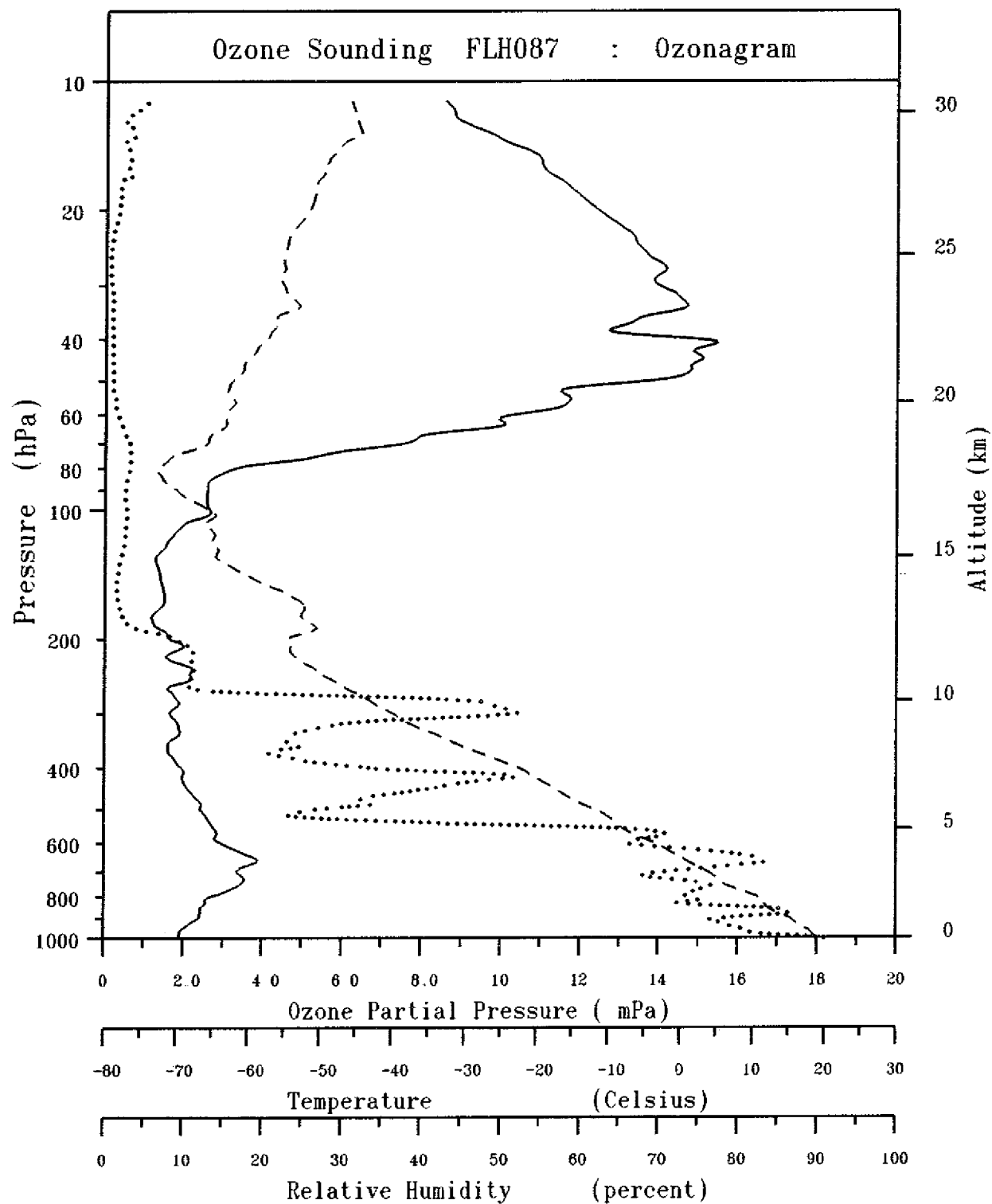
Date 04-10-1988
 Time at launch 22:15 (UTC)
 Location 27:33 S , 30:00 W

— Ozone
 --- Temperature
 Relative Humidity



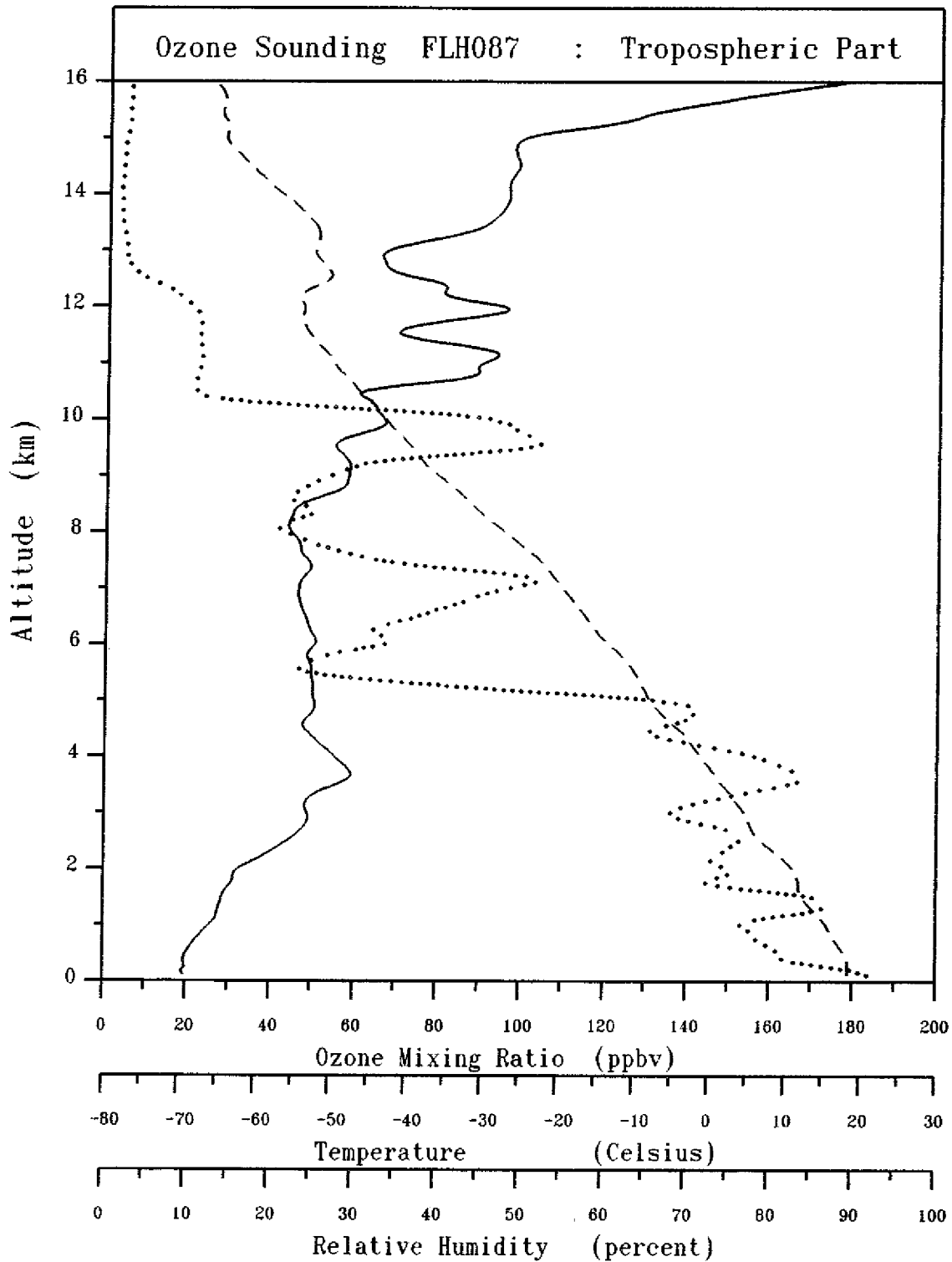
Date 04-10-1988
 Time at launch 22:15 (UTC)
 Location 27:33 S , 30:00 W

— Ozone
 --- Temperature
 Relative Humidity



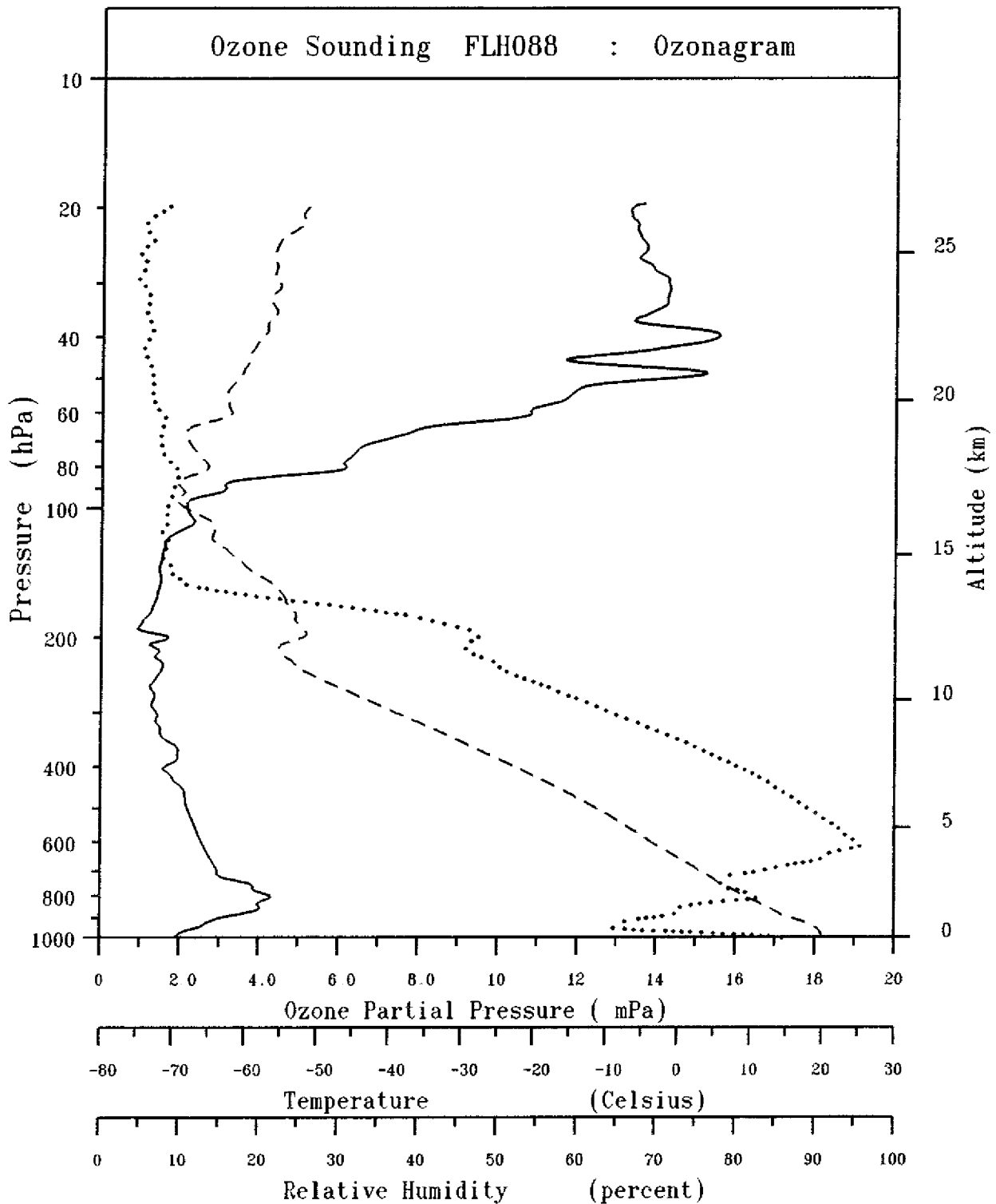
Date 05-10-1988
 Time at launch 11:45 (UTC)
 Location 30:04 S , 30:36 W

— Ozone
 --- Temperature
 Relative Humidity

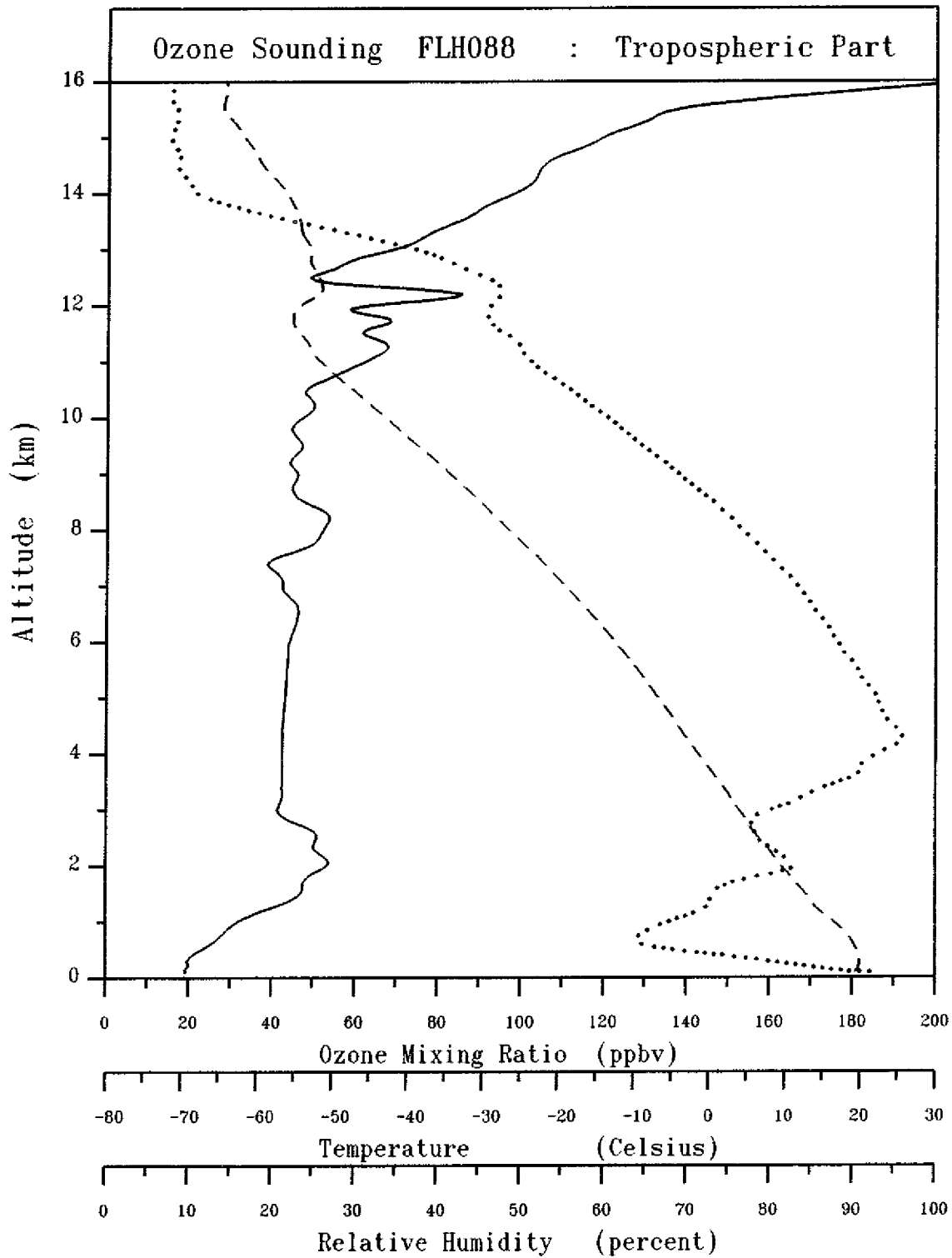


Date 05-10-1988
 Time at launch 11:45 (UTC)
 Location 30:04 S , 30:36 W

— Ozone
 - - - Temperature
 Relative Humidity

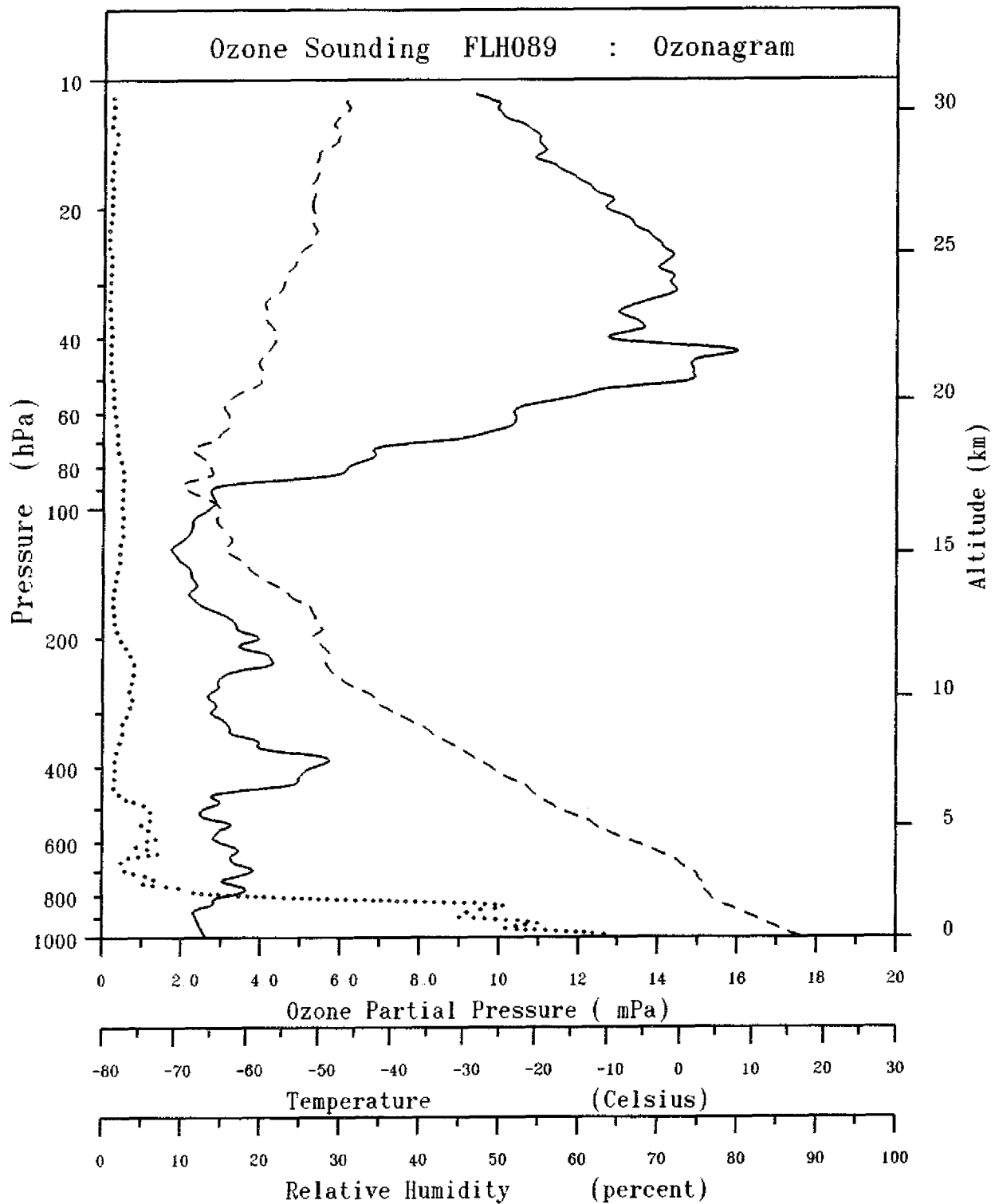


Date	05-10-1988	—	Ozone
Time at launch	23:00 (UTC)	- - -	Temperature
Location	30:24 S , 33:36 W	.....	Relative Humidity



Date 05-10-1988
 Time at launch 23:00 (UTC)
 Location 30:24 S , 33:36 W

— Ozone
 --- Temperature
 Relative Humidity



Date 06-10-1988

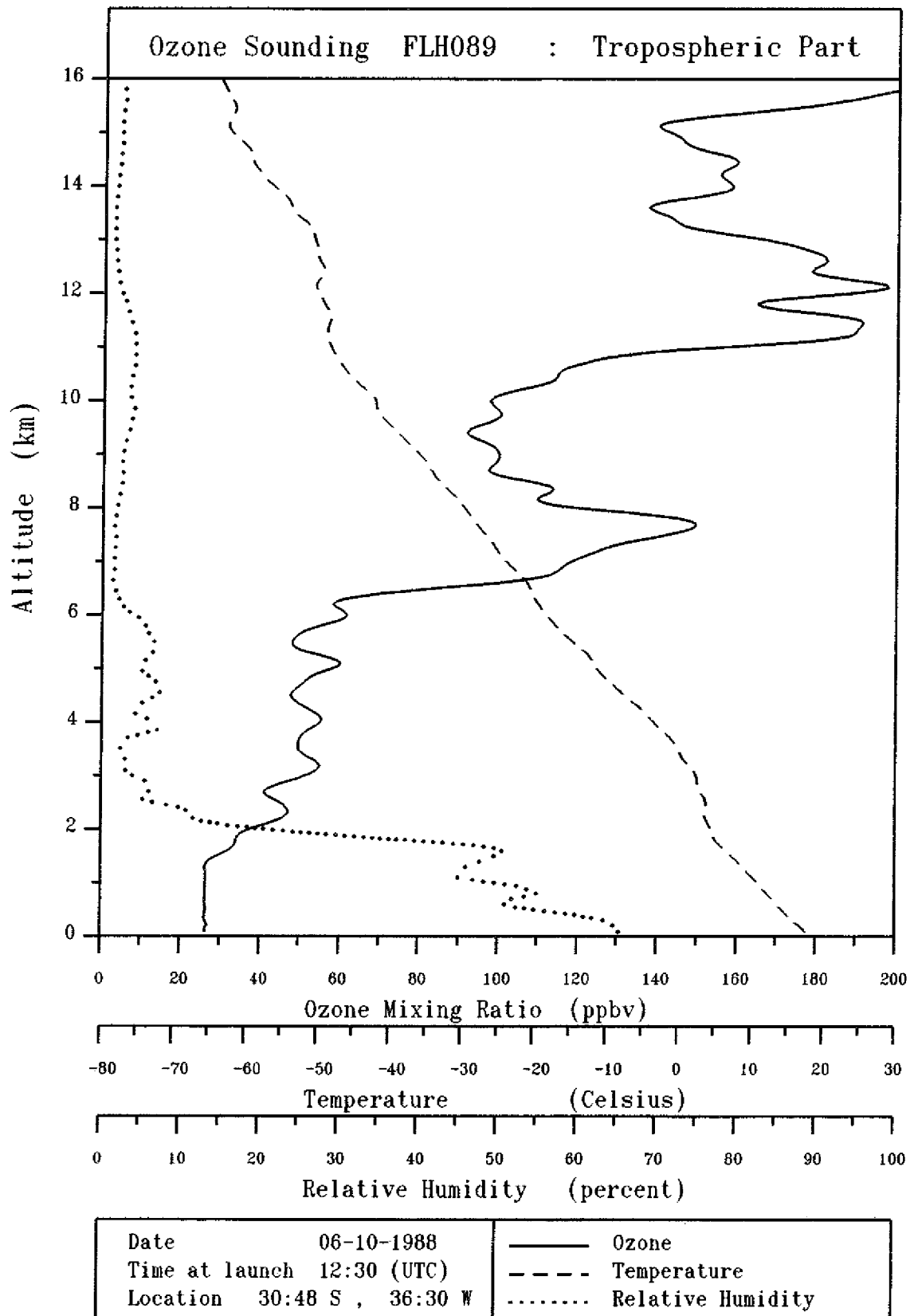
Time at launch 12:30 (UTC)

Location 30:48 S , 36:30 W

— Ozone

- - - Temperature

..... Relative Humidity



Jül-2567
December 1991
ISSN 0366-0885