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Observation of Stratospheric Ozone with MT-135 Rockets in 1990 - 1999

By

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Abstract : The stratospheric ozone profiles have been measured with use of the optical ozonesonde aboard the MT-135 rockets flown from Uchinoura (31N, 131E), Kagoshima as a activity of the program for the monitoring long term change in stratospheric ozone. The measurements have been conducted routinely every year in August-September season, with one or two flights/year since August 1990. So far eighteen ozone profiles have been obtained in 1990 - 1999. The rocket flights also provide atmospheric temperature and neutral wind components in the stratosphere and the troposphere. These atmospheric data and the simultaneous ground measurements are compiled and presented in this data book.

1 Introduction

Precise measurements of ozone concentrations in the stratosphere are required to monitor the global change of stratospheric ozone which is the resources essential to every terrestrial life. The significant ozone decline is expected in the upper stratosphere from 35-50 km altitude. Satellite and ground-based mesurements are both capable to monitor the ozone in this atitude region. However, the accuracies of the remote sensing measuremens should be calibrated by the direct measurements. Rocket provides important direct measurements at these altitudes. The rocket-borne optical measurements for stratospheric ozone employ the solar ultraviolet absorption method and the instrument is a multi-wavelength solar radiometer. An rocket-borne optical ozonesonde (ROOZ) was developed in 1987, and the original MT-135 rocket has been modified to accomodate the ROOZ in 1989 (Ref). Since the first successful measurement was made in August 1990 from Uchinoura (31N, 131E) so far we obtain fifteen ozone profiles in August-September, and three in January-February. As the rocket-borne photometer provides stratospheric ozone profiles down to 18 or 17 km, the ECC ozonesonde is used to ozone profile in the troposphere(0 to approximately 17 km), and also provides lower stratospheric ozone up to 25-28 km altitudes, and is used to compare with profiles obtained with ROOZ. The atmospheric temperature in the stratosphere and the troposphere is also measured simultaneously with the temperature sensor aboard MT-135 rocket. Atmospheric wind components in the stratosphere and the troposphere are deduced from the tracking data of the payload. These data provide information on the thermodynamical structure of the stratosphere.

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The measurements are carried out in August or September, when the stratosphere over the launching site is most stable in a year so that the measured ozone profiles are thought to be free from large scale disturbances. Moreover, two rocket experiments have been usually carried out in two successive days in a season to evaluate the small day-to-day temporal variations of ozone. The launching time is set to be 1100JST when the diurnal variation of ozone is minimum although diurnal variation is expected to be less than 1% below 50 km altitude. Although most experiments are carried out in August-September season, three of the all flights, MT-135-53, 54 and 65, have been launched in wintertime mainly because of the flight schedules at the launching site.

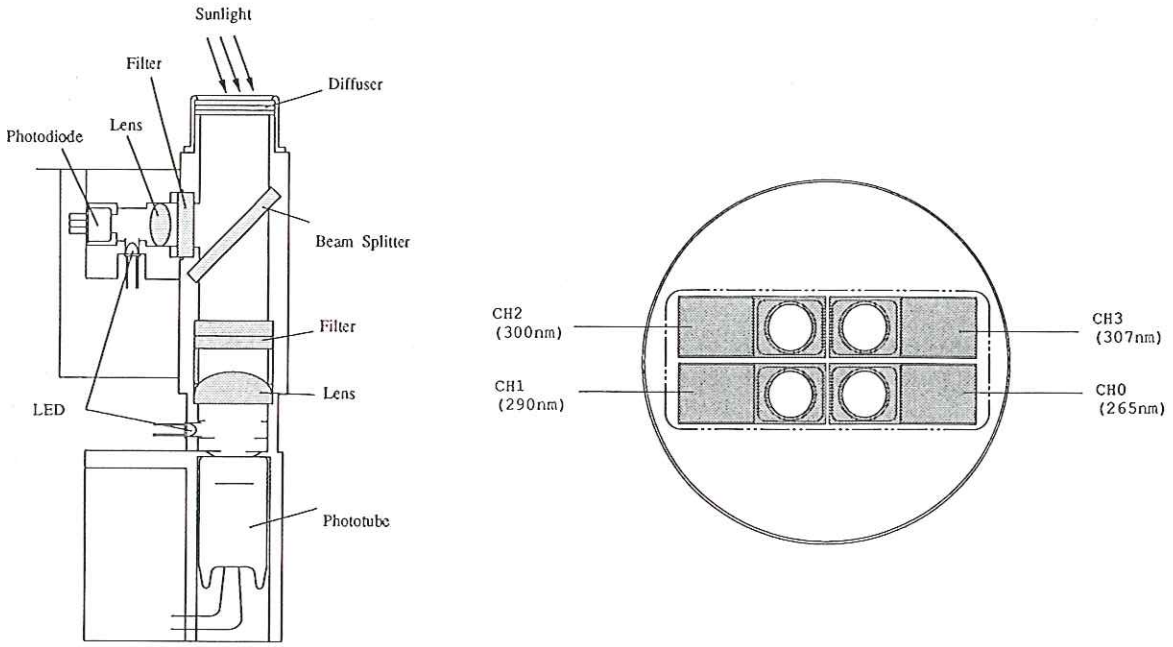

Figure 1. Optical diagram of one of the ozone photometer (left), and top view of the instrument (right).

2 Instrument

The optical ozone sensor is a multi-color filter photometer (Fig. 1) consisted of four independent photometer to measure the attenuation of the solar ultraviolet (UV) at four wavelengths. The central wavelengths are set at 265, 290, 300 and 307 nm, respectively with a passband (full width at half maximum) of 10-12nm. Each photometer receives the solar uv with a teflon diffuser plate installed at the top of the instrument container. The effective aperture of the diffuser plate is 15 mm diameter. The light transmitted through the diffuser plate passes through a beam splitter plate, filter, and a focussing lens, and the phototube with SbCs photocathode. Owing to the diffuser plate we do not need any pointing device for the sun. For the correction of the diffuser radiance change depending on the incident angle of the solar uv onto the diffuser plate, the light from the diffuser plate is monitored at 420 nm with 12 nm passband through the reflection by the beam splitter with Si photodide detector. Rationing the measured UV radiance intensity to the reference 420 nm intensity eliminates the modulation due to the change of the solar incident angle onto the photometer. Transmission functions for the ultraviolet filters are individually measured with using the calibration instruments at Tsukuba College of Technology, and the transmission function for the diffuser plate and the photodetector response are representative as measured by the same facility and by the manufacturer.

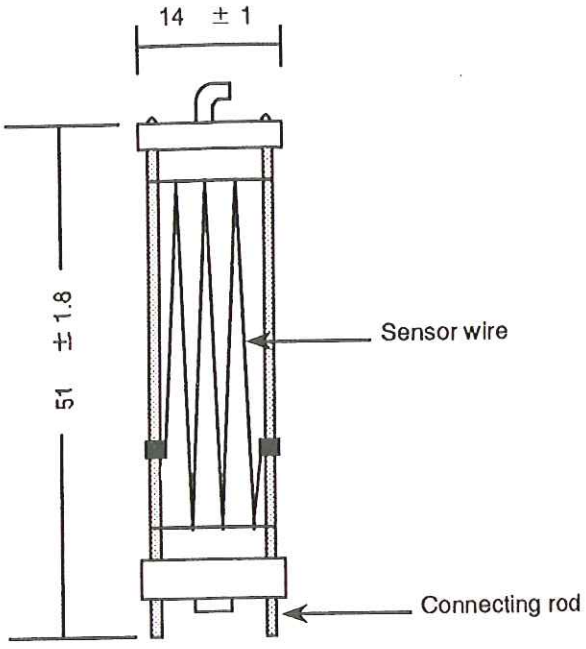

Figure 2. Temperature sensor aboard MT-135 rocket

The dropsonde consists of the ozone photometer, a temperature sensor (Fig. 2), and a radar transponder / telemeter along with a parachute. The dropsonde is placed in a airtight container installed in the payload section of the rocket. The payload is separated and ejected from the rocket at 95 sec after the launch. The dropsonde is ejected out of the container at 112 sec. The temperature sensor is deployed from the dropsonde at 117 sec. The single staged rocket reaches its apex of 56 - 60 km at about 110 sec after launch. The 6.8 kg payload is hung from a parachute with a diameter of 3.5 m, and descends slowly through the stratosphere and troposphere (Fig. 3). Typical flight duration is about 100 minutes long.

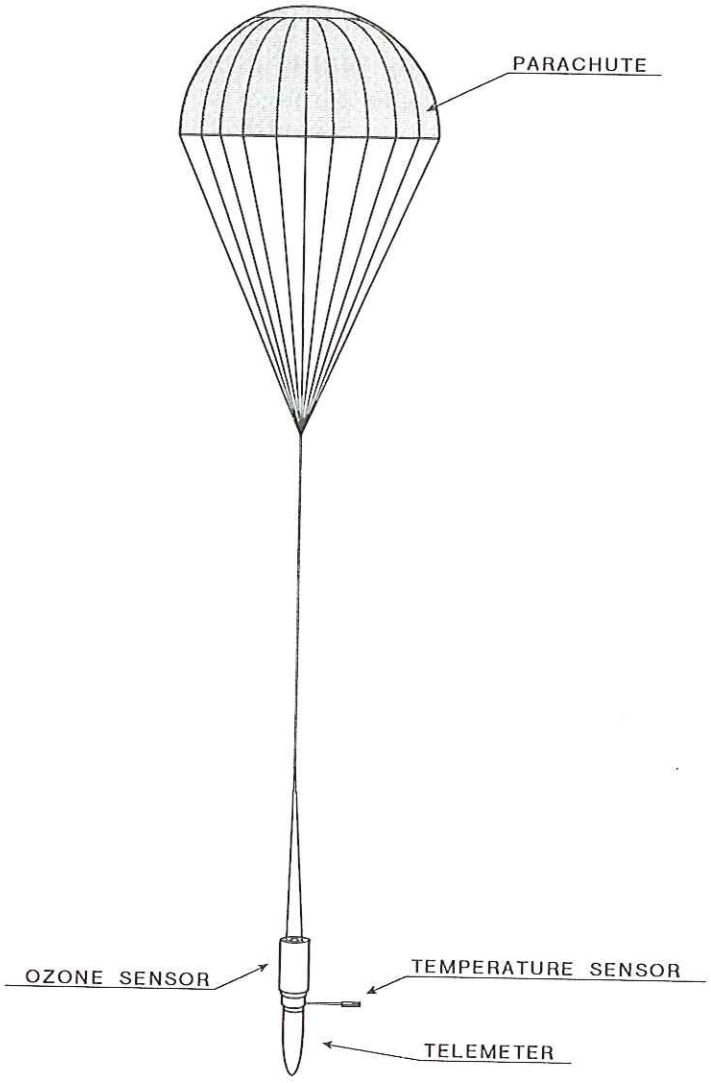

Figure 3. Pictorial view of the decelerator (parachute) and the payload

The output signals from the photometer and the temperature sensor are converted in to 40 bits digital form with a 10-bit A/D converter. Every 40 bits data contain 8 bit frame counter, 2 bit filter ID, 10 bit ozone (uv) and reference (420 nm) counts and 10 bit temperature data. These data are transmitted to the ground station every 4 msec interval via a 1687 MHz PCM transmitter. The realtime 10kbps data received by the ground station are converted in to a random access file. The transmitter also works as a radar transponder and the dropsonde is continuosly tracked with a 3.5 m ϕ ground based radar. Positioning accuracy of the radar tracking system is approximately 50 m. The positioning data are also used to deduce the horizontal wind.

Data Analysis

The measured attenuation of solar UV due to ozone is converted to ozone column density along the solar ray path as a function of altitude using effective ozone absorption cross section for the wavelength range of filter pass band. In the retrieval procedure, we subtracted small component of the solar UV extinction due to the Rayleigh scattering of the atmosphere. We use the solar flux of Mentall et al., (1981, 1988) and the absorption cross sections of ozone measured by Bass and Paur (1985). A quadratic spline function is fitted to the derived column density against altitude with every 1 km bin, and the number density is derived as a derivative of this function. Four ozone number density profiles are retrieved from the attenuation curves measured at four wavelength bands. Evaluating the retrieval sensitivity in the altitude range for each wavelength band, a synthesized ozone profile is obtained by taking with a weighted mean of the four ozone profiles. Error analysis for the present measurements deals with the ozone effective absorption coefficient, quadratic fitting residuals for absorption data. Systematic errors are evaluated mainly from the standard deviation for the determination of the synthetic profile. The overall retrieval error in the derived ozone density is estimated to be about 3-10% at altitudes between 25 and 50km.

Acknowledgements

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Compiled data

1. Electro-Chemical Cell (ECC) ozonesonde

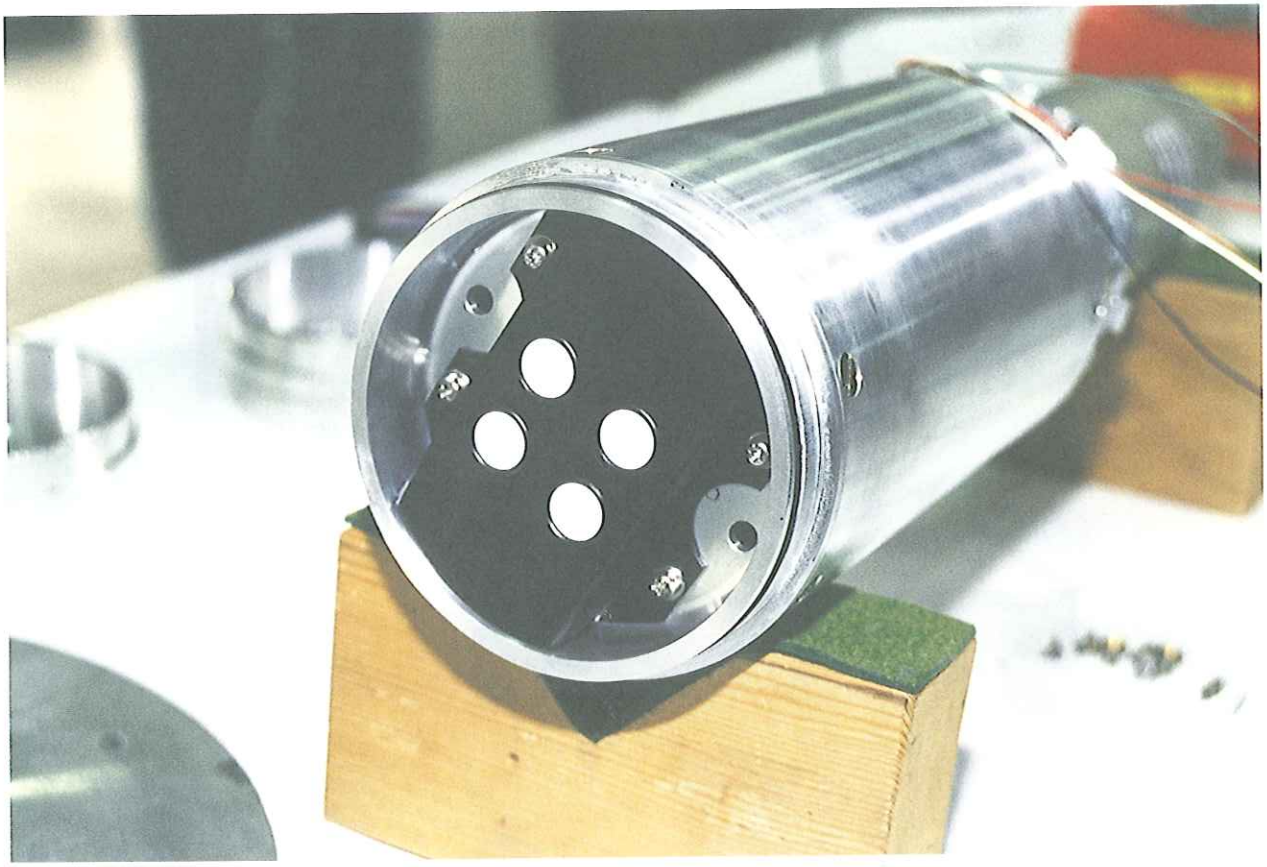
ECC balloon-borne ozonesondes are launched at Uchinoura. The purpose of the observation is to obtain the vertical distribution of atmospheric ozone and to compare with the ozone density obtained by the ROOZ. Usually the balloon-borne ozonesondes are launched on one day before and on the same day when the rocket-borne ozonesonde observations are conducted. We use KC-79 and KC-96 (after 1998) type ECC ozonesondes which are used by Japan Meteorological Agency for ozone observation. Photogaph 7 shows ECC ozonesonde launching at Uchinoura.

2. Temperature

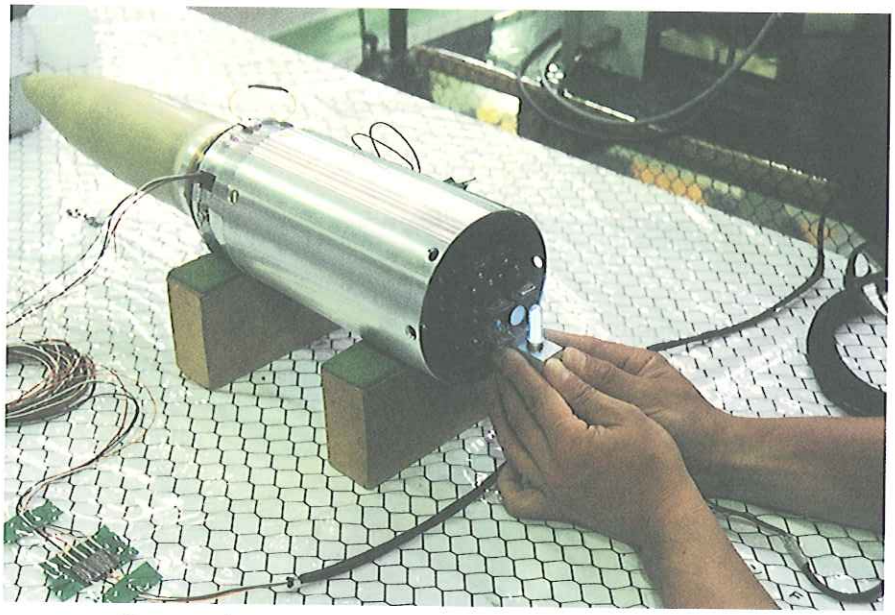
The temperature sensor is a wire of Fe - Ni alloy with a diameter of 20 mm and approximate length of 18 cm. The atmospheric temperature is obtained by measuringthe electrical resistence of the metal wire as it depends on the temperature of the ambient atmosphere. The temperature characteristics details of the wire is described elsewhere (Watanabe et al., 1992).

3. Wind components

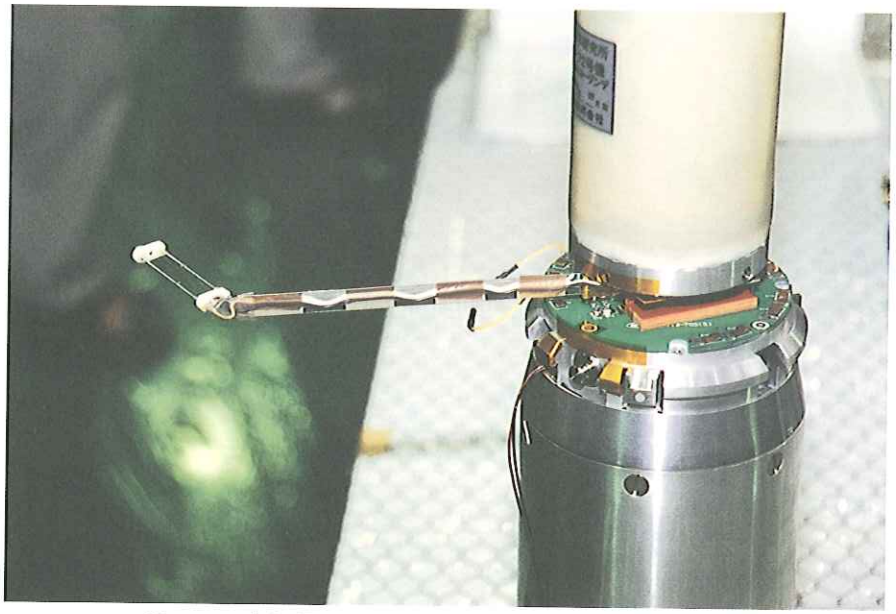
The radar tracking data consisted of range distance, azimuthal and elevation angles of the payload from the ground receiver with a sampling rate of 1s. We calculate the distance and azimuth between the payload and the point of the receiver projected to the horizontal plane including the payload. Two sets of the distance and the azimuth enables us to determine the magnitude and direction of the horizontal wind (Watanabe et al., 1992).



Photograph 1. MT-135 optical ozonesonde



Photograph 2. Checking of the ozone photometer with a UV lamp

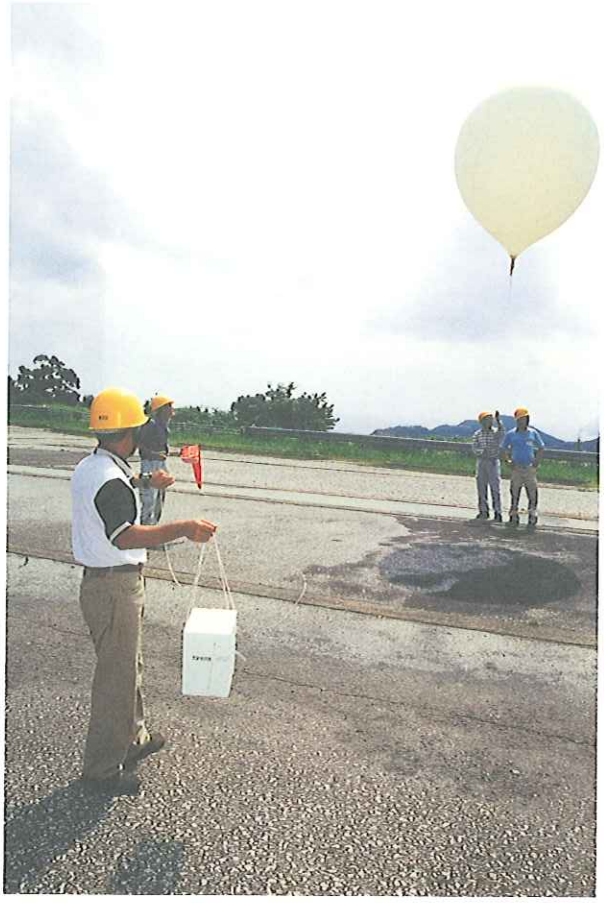


Photograph 3. Temperature sensor after the deployment test

Photograph 4.
Payload section of the MT-135 rocket mounted on the V-test stage

Photograph 5. MT-135 rocket on the launcher at Uchinoura.

Photograph 6. MT-135 rocket launching at Uchinoura



Photograph 7. ECC ozonesonde launching at Uchinoura

Table I -1～21. Flight/Photometer characteristics

	MT-135-52
launch date	8/27/1990
time, set angle	1110JST 80°
Apogee	57 km 110s
Nose Cone Ejection	94s
Parachute Ejection	112s
Filter Moter On	117s
End of Observation	3800s
Distance	22.9km
Altitude	5.2km
Weather	Fair
	E 4m/s
	29℃
Solar zenith angle χ	21.4°
sec χ	1.07

channel	λ	$\Delta\lambda$	TM (volts)	Ozone profile interval (km)
C0	264.0	11.0	4.0 (55 km)	52 - 38
C1	288.5	15.3	4.4	51 - 23
C2	301.0	12.2	3.6	45 - 19
C3	306.0	9.7	4.2	40 - 18
REF	422.5	12.0	4.1	

	MT-135-53
launch date	2/9/1991
time, set angle	1100JST 80.5°
Apogee	57 km 112s
Nose Cone Ejection	96s
Parachute Ejection	111s
Filter Moter On	115s
End of Observation	3655s
Distance	155.4km
Altitude	5.7km
Weather	Cloud Cover
	E 2.5m/s
	13.4℃
Solar zenith angle χ	46.5°
sec χ	1.43

Raw signal characteristics

There were frequent lock offs of raw signals between 32 and 27 km, and resulted relatively large ozone density errors in these altitudes.

channel	λ	$\Delta\lambda$	TM (volts)	Ozone profile interval (km)
C0	266.3	11.3	1.7 (50 km)	52 - 40
C1	285.7	12.6	2.8	48 - 23
C2	299.5	12.9	2.8	43 - 19
C3	305.9	10.1	2.9	40 - 18
REF	418.0	12.0	5.0	

	MT-135-54
launch date	2/11/1991
time, set angle	1110JST 80°
Apogee	62 km 116s
Nose Cone Ejection	95s
Parachute Ejection	113s
Filter Moter On	118s
End of Observation	2950s
Distance	145.7km
Altitude	8.3km
Weather	Cloud Cover
	NW 1m/s
	14℃
Solar zenith angle χ	45.9°
sec χ	1.44

Raw signal characteristics

Occasional Noise

channel	λ	$\Delta\lambda$	TM (volts)	Ozone profile interval (km)
C 0	266.3	11.3	2.6 (50 km)	57 - 38
C 1	287.6	12.6	3.6	50 - 23
C 2	298.5	12.9	4.6	46 - 18
C 3	305.9	10.1	4.7	44 - 17
REF	418.0	12.0	4.5	

	MT-135-55
launch date	9/11/1991
time, set angle	1100JST 80°
Apogee	56.3 km 110s
Nose Cone Ejection	95s
Parachute Ejection	113.5s
Filter Moter On	118s
End of Observation	3876s
Distance	32.1km
Altitude	5.1km
Weather	Fair
	E 1.5m/s
	27℃
Solar zenith angle χ	27.1°
sec χ	1.12

channel	λ	$\Delta\lambda$	TM (volts)	Ozone profile interval (km)
C0	265.9	9.5	1.7 (52 km)	54 - 38
C1	286.7	12.3	3.2	50 - 25
C2	300.8	12.4	3.4	46 - 18
C3	308.0	11.3	4.6	40 - 17
REF				
	420.8	12.5	2.8	

	MT-135-56
launch date	9/12/1991
time, set angle	1100JST 82°
Apogee	56.8 km 110s
Nose Cone Ejection	96s
Parachute Ejection	113s
Filter Moter On	117s
End of Observation	3875s
Distance	50.3km
Altitude	4.6km
Weather	Fair
	E 2m/s
	28.5℃
Solar zenith angle χ	27.5°
sec χ	1.13

channel	λ	$\Delta\lambda$	TM (volts)	Ozone profile interval (km)
C0	265.6	9.5	1.7 (52 km)	54 - 38
C1	286.7	12.9	3.2	50 - 26
C2	298.8	13.3	3.4	45 - 19
C3	308.0	11.4	4.6	40 - 18
REF	420.3	12.3	2.8	

	MT-135-57
launch date	9/9/1992
time, set angle	1100JST 81°
Apogee	56.1 km 109s
Nose Cone Ejection	96s
Parachute Ejection	113s
Filter Moter On	118s
End of Observation	860s
Distance	27.5km
Altitude	0.5km
Weather	Fair
	SE 2m/s
	25.8℃
Solar zenith angle χ	26.5°
sec χ	1.12

Raw data characteristics

The payload descended rather fast probably because of decelerator opening trouble. The attitude of the payload was not disturbed and was similar to a typical flight.

channel	λ	$\Delta\lambda$	TM (volts)	Ozone profile interval (km)
C0	267.1	12.3	3.3 (56 km)	55 - 37
C1	289.1	12.8	3.8	53 - 26
C2	298.8	13.1	4.9	46 - 18
C3	308.5	11.5	3.3	40 - 18
REF			3.6	

	MT-135-58
launch date	9/23/1993
time,se angle	1100JST 78°
Apogee	55.8 km 110s
Nose Cone Ejection	96s
Parachute Ejection	112s
Temperature sensor deployment	119s
End of Observation	3510s
Distance	60.4km
Altitude	7.0km
Weather	Cloud Cover
	NNW 1m/s
	22.7℃
Solar zenith angle χ	31.6°
sec χ	1.17

channel	λ	$\Delta\lambda$	TM (volts)	Ozone profile interval (km)
C0	267.1	12.3	4.9 (56 km)	55 - 37
C1	289.1	12.8	3.1	51 - 22
C2	298.8	13.1	S	N.A.
C3	308.5	11.5	5.3	N.A.
REF				
R0			5.0	
R1			4.8	
R2			5.2	
R3			5.0	

	MT-135-59
launch date	9/24/1993
time, set angle	1100JST 80°
Apogee	55.5km 109s
Nose Cone Ejection	96s
Parachute Ejection	114s
Temperature sensor deployment	118s
End of Observation	2460s
Distance	36.6km
Altitude	11.8km
Weather	Fair
	E 2.5m/s
	24.6℃
Solar zenith angle χ	32.0°
sec χ	1.18

channel	λ	$\Delta\lambda$	TM (volts)	Ozone profile interval (km)
C 0	265.9	11.8	1.8 (56 km)	53 - 38
C 1	289.5	11.6	1.9	50 - 20
C 2	298.8	13.1	3.6	46 - 18
C 3	309.3	11.5	2.8	38 - 18
REF				
R 0		10.7	4.9	
R 1		10.6	5.0	
R 2		10.5	4.9	
R3		9.8	5.0	

	MT-135-60
launch date	9/6/1994
time, set angle	1100JST 79°
Apogee	56.0km 109s
Nose Cone Ejection	97s
Parachute Ejection	114s
Temperature sensor deployment	117s
End of Observation	5160s
Distance	19.6km
Altitude	1.3km
Weather	Cloud Cover
	S 2m/s
	28.7℃
Solar zenith angle χ	25.4°
sec χ	1.11

Raw data characteristics

The data were reduced from 53 to 18 km. In the overlap region ovel 45 km, ozone densities from c0 were 15% higher than C1. In the overlap region from 38 km to 25 km, C2 results were 2% higher than C3 ozone densities. The merged results were in Table II.

channel	λ	$\Delta\lambda$	TM (volts)	Ozone profile interval (km)
C0	264.9	10.3	1.8 (56 km)	53 - 38
C1	290.3	13.3	1.9	48 - 22
C2	297.9	13.1	3.6	46 - 18
C3	305.0	10.3	2.8	38 - 18
REF				
R0	419.6	10.7	2.2	
R1	418.8	10.5	2.0	
R2	420.8	10.6	2.0	
R3	421.2	10.6	2.1	

	MT-135-61
launch date	9/7/1994
time, set angle	1100JST 80°
Apogee	56.0km 108s
Nose Cone Ejection	98s
Parachute Ejection	115s
Temperature sensor deployment	119s
End of Observation	5279s
Distance	15.3km
Altitude	1.5km
Weather	Fair
	SE 3m/s
	29.3℃
Solar zenith angle χ	25.8°
sec χ	1.11

channel	λ	$\Delta\lambda$	TM (volts)	Ozone profile interval (km)
C0	265.5	10.0	1.3 (56 km)	54 - 37
C1	292.0	10.6	2.3	51 - 22
C2	298.3	13.1	4.5	48 - 20
C3	304.9	10.0	3.7	40 - 18
REF				
R0	420.0	9.8	2.2	
R1	420.1	9.6	2.0	
R2	420.1	9.8	2.2	
R3	419.5	10.2	2.2	

	MT-135-62
launch date	9/15/1994
time, set angle	1100JST 77°
Apogee	55km 108s
Nose Cone Ejection	96s
Parachute Ejection	114s
Temperature sensor deployment	118s
End of Observation	4530s
Distance	50.0km
Altitude	3.6km
Weather	Fair
	NNE 2.5m/s
	26.1℃
Solar zenith angle χ	28.5°
sec χ	1.14

channel	λ	$\Delta\lambda$	TM (volts)	Ozone profile interval (km)
C0	265.7	12.3	1.0 (55 km)	53 - 37
C1	290.8	13.4	1.9	50 - 22
C2	298.6	12.3	4.2	45 - 20
C3	305.8	10.0	3.5	41 - 18
REF				
R0	418.1	10.7	4.8	
R1	418.1	10.6	4.5	
R2	418.5	10.5	5.0	
R3	419.6	9.8	4.5	

	MT-135-63
launch date	9/18/1995
time, set angle	1100JST 77°
Apogee	53km 106s
Nose Cone Ejection	96s
Parachute Ejection	113s
Temperature sensor deployment	117s
End of Observation	4300s
Distance	78.3km
Altitude	4.3km
Weather	Fair
	NE 3m/s
	24℃
Solar zenith angle χ	29.6°
sec χ	1.15

channel	λ	$\Delta\lambda$	TM (volts)	Ozone profile interval (km)
C0	264.0	11.0	0.7 (55 km)	51 - 38
C1	288.5	15.3	2.1	48 - 20
C2	301.0	12.2	3.0	48 - 18
C3	306.0	9.7	3.6	40 - 16
REF				
R0	418.1	10.2	4.5	
R1	418.2	10.1	3.0	
R2	418.6	10.1	4.4	
R3	419.7	11.7	4.6	

	MT-135-64
launch date	9/15/1996
time, set angle	1100JST 80°
Apogee	56km 110s
Nose Cone Ejection	95s
Parachute Ejection	113s
Temperature sensor deployment	117s
End of Observation	2835s
Distance	38.3km
Altitude	10.1km
Weather	Fair
	E 2.5m/s
	25℃
Solar zenith angle χ	28.5°
sec χ	1.14

Raw data characteristics

All of the radiometers output was verylow during parachute ejection(113s) to 133s(54.1km). Complete lockout from 225s(45.3km) to 309s(40.4km) Frequent lockout continues through 1475s(19km), then complete lockout of optical signal channel follows. The raw data quality is not sufficient to produce ozone profiles.

OZONE

channel	λ	$\Delta\lambda$	TM (volts)	Ozone profile interval (km)
C0	267.5	12.5	3.7 (55 km)	N.A.
C1	291.9	11.9	3.6	N.A
C2	297.8	13.8	2.0	N.A
C3	305.8	10.1	3.8	N.A

REF

R0	418.3	10.1	2.2
R1	418.2	9.8	2.2
R2	418.7	9.8	2.1
R3	418.7	10.1	2.2

	MT-135-65
launch date	1/13/1997
time, set angle	1100JST 78°
Apogee	55km 110s
Nose Cone Ejection	96s
Parachute Ejection	114s
Temperature sensor deployment	118s
End of Observation	3718s
Distance	10.3km
Altitude	3.7km
Weather	Fair
	E 1m/s
	12℃
Solar zenith angle χ	52.6°
sec χ	1.65

OZONE

channel	λ	$\Delta\lambda$	TM (volts)	Ozone profile interval (km)
C0	267.5	12.8	3.3 (55 km)	49 - 38
C1	291.6	11.7	4.3	48 - 18
C2	298.1	13.8	2.5	46 - 17
C3	306.8	11.1	3.0	44 - 16

REF

R0	418.3	9.8	3.7	
R1	418.2	9.8	2.0	
R2	418.7	10.0	2.3	
R3	418.7	9.6	2.0	

	MT-135-66
launch date	9/8/1997
time, set angle	1100JST 79°
Apogee	50.4km 102s
Nose Cone Ejection	96s
Parachute Ejection	113s
Temperature sensor deployment	117s
End of Observation	5240s
Distance	13.8km
Altitude	1.3km
Weather	Fair
	E 0.5m/s
	26℃
Solar zenith angle χ	25.8°
sec χ	1.11

OZONE

channel	λ	$\Delta\lambda$	TM (volts)	Ozone profile interval (km)
C0	266.8	9.4	3.4	48 - 37
C1	289.7	11.6	4.8	47 - 17
C2	299.1	12.1	4.0	45 - 22
C3	306.3	11.7	3.0	43 - 18

REF

R0	420.3	10.8	1.3
R1	419.7	11.0	1.1
R2	419.8	10.7	0.9
R3	421.3	11.7	1.1

	MT-135-66
launch date	9/8/1997
time, set angle	1100JST 79°
Apogee	50.4km 102s
Nose Cone Ejection	96s
Parachute Ejection	113s
Temperature sensor deployment	117s
End of Observation	5240s
Distance	13.8km
Altitude	1.3km
Weather	Fair
	E 0.5m/s
	26℃
Solar zenith angle χ	25.8°
sec χ	1.11

OZONE

channel	λ	$\Delta\lambda$	TM (volts)		Ozone profile interval (km)
C0	266.8	9.4	3.4		48 - 37
C1	289.7	11.6	6.8		47 - 17
C2	299.1	12.1	4.0		45 - 22
C3	306.3	11.7	3.0		43 - 18
REF					
R0	420.3	10.8	1.3		
R1	419.7	11.0	1.1	REF	
R2	419.8	10.7	0.9		
R3	421.3	11.7	1.1		

	MT-135-67
launch date	9/9/1997
time, set angle	1100JST 80°
Apogee	52.4km 102s
Nose Cone Ejection	96s
Parachute Ejection	113s
Temperature sensor deployment	117s
End of Observation	4766s
Distance	15.6km
Altitude	2.3km
Weather	Fair
	SSW 0.5m/s
	29℃
Solar zenith angle χ	26.1°
sec χ	1.11

OZONE

channel	λ	$\Delta\lambda$	TM (volts)	Ozone profile interval (km)
C0	267.3	9.1	4.5	48 - 36
C1	291.9	13.8	5.0	52 - 17
C2	300.0	11.3	3.6	46 - 18
C3	305.6	11.3	4.7	40 - 17

REF

R0	418.1	10.7	1.3
R1	418.0	11.0	1.2
R2	418.2	11.1	1.0
R3	418.2	11.0	1.0

	MT-135-68
launch date	9/7/1998
time, set angle	1100JST 76°
Apogee	56.7km 109s
Nose Cone Ejection	96s
Parachute Ejection	113s
Temperature sensor deployment	117s
End of Observation	5100s
Distance	65.5km
Altitude	1.4km
Weather	Fair
	N 3.0m/s
	25℃
Solar zenith angle χ	25.7°
sec χ	1.11

Raw data characteristic

OZONE

channel	λ	$\Delta\lambda$	TM (volts)	Ozone profile interval (km)
C0	266.2	11.4	3.4	56 - 37
C1	290.1	11.8	3.0	56 - 21
C2	299.4	12.8	3.6	50 - 18
C3	307.1	11.1	3.4	47 - 18

REF

R0	421.1	12.8	3.8
R1	421.3	12.7	3.7
R2	421.1	12.6	3.7
R3	420.7	12.6	3.7

	MT-135-69
launch date	9/8/1998
time, set angle	1100JST 80.5°
Apogee	57.6km 105s
Nose Cone Ejection	96s
Parachute Ejection	113s
Temperature sensor deployment	118s
End of Observation	5111s
Distance	65.5km
Altitude	1.7km
Weather	Fair
	SE 2m/s
	28℃
Solar zenith angle χ	26.0°
sec χ	1.11

OZONE

channel	λ	$\Delta\lambda$	TM (volts)	Ozone profile interval (km)
C0	266.1	11.4	3.5	53 - 37
C1	290.4	11.8	2.7	53 - 21
C2	299.8	12.8	3.1	52 - 17
C3	307.0	11.1	3.2	50 - 18

REF

R0	421.7	12.6	3.6
R1	421.4	12.8	3.7
R2	421.7	13.0	3.8
R3	421.0	13.0	3.7

	MT-135-70
launch date	9/7/1999
time, set angle	1100JST 80°
Apogee	55.1km 107s
Nose Cone Ejection	95s
Parachute Ejection	113s
Temperature sensor deployment	117s
End of Observation	5013s
Distance	27.3km
Altitude	2.1km
Weather	Fair
	SE 2.5m/s
	27℃
Solar zenith angle χ	25.7°
sec χ	1.11

OZONE

channel	λ	$\Delta\lambda$	TM (volts)	Ozone profile interval (km)
C0	266.4	11.4	2.1	54 - 37
C1	288.9	11.8	1.7	52 - 20
C2	299.7	12.8	2.3	45 - 17
C3	306.3	11.1	2.2	40 - 17

REF

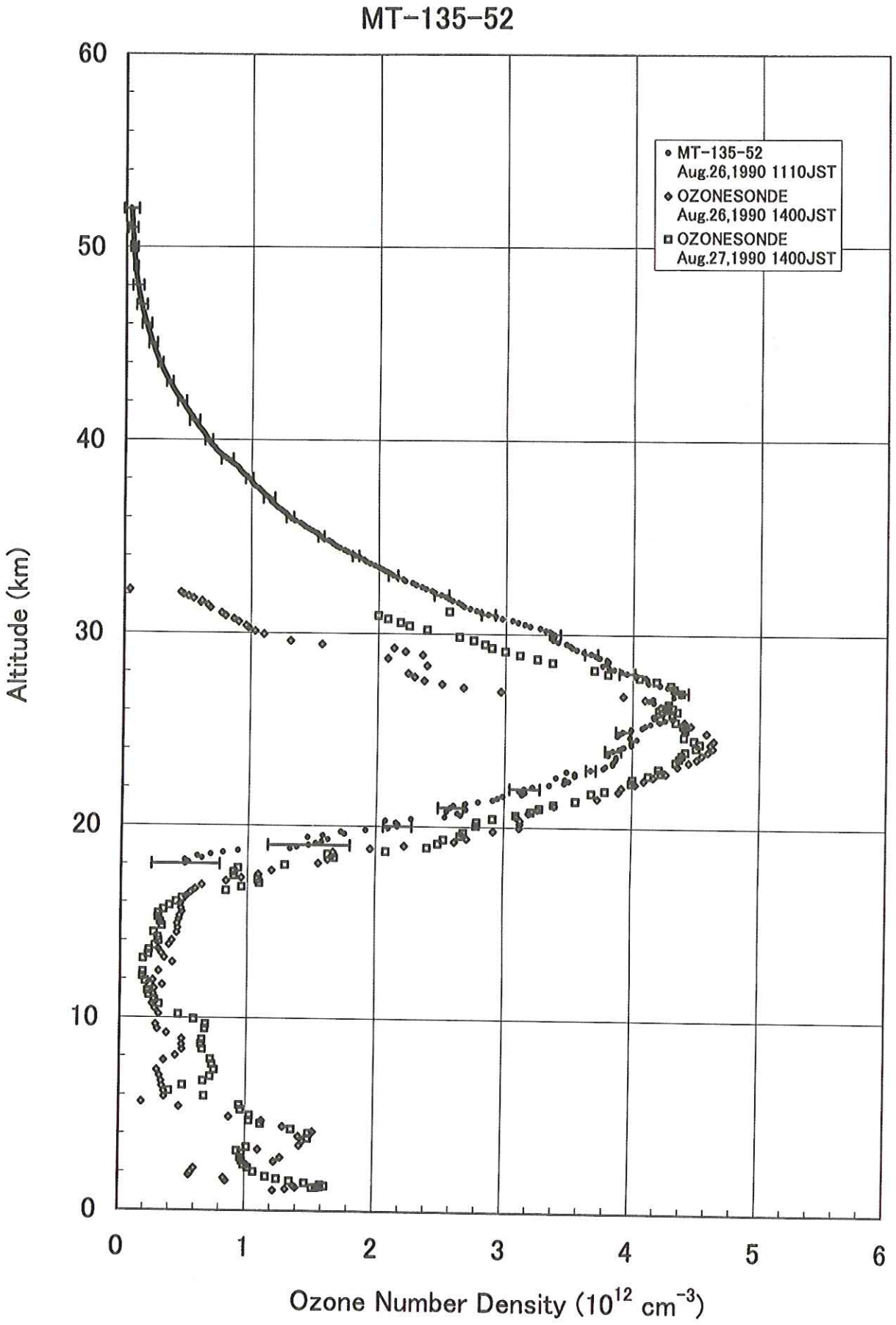
R0	421.6	11.1	3.2
R1	421.6	11.0	3.6
R2	420.6	10.8	3.3
R3	420.5	11.0	3.2

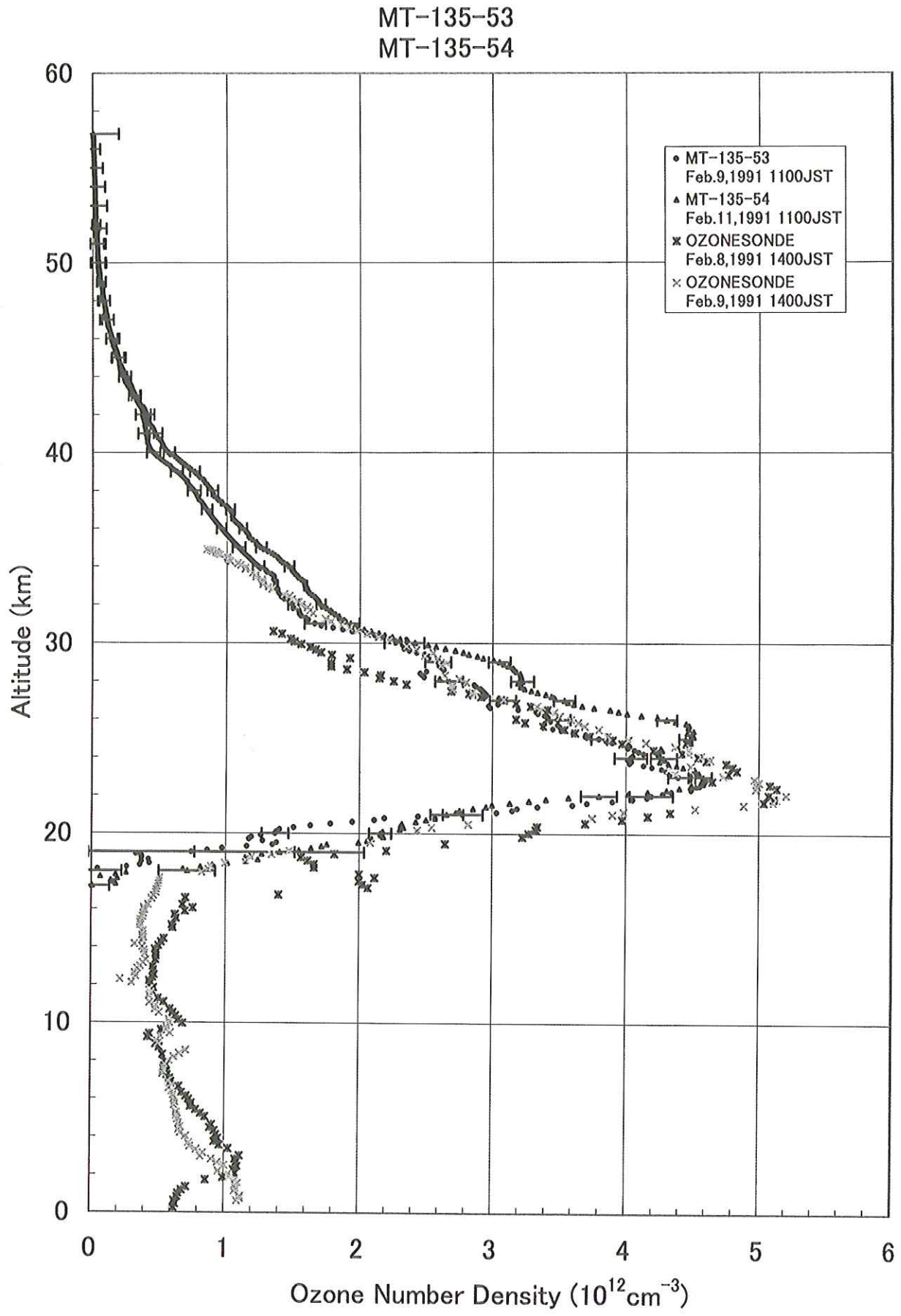
	MT-135-71
launch date	9/11/1999
time, set angle	1100JST 75°
Apogee	54.7km 106s
Nose Cone Ejection	96s
Parachute Ejection	113s
Temperature sensor deployment	118s
End of Observation	458s
Distance	43.0km
Altitude	0.6km
Weather	Fair
	SW 5m/s
	28℃
Solar zenith angle χ	27.1°
sec χ	1.12

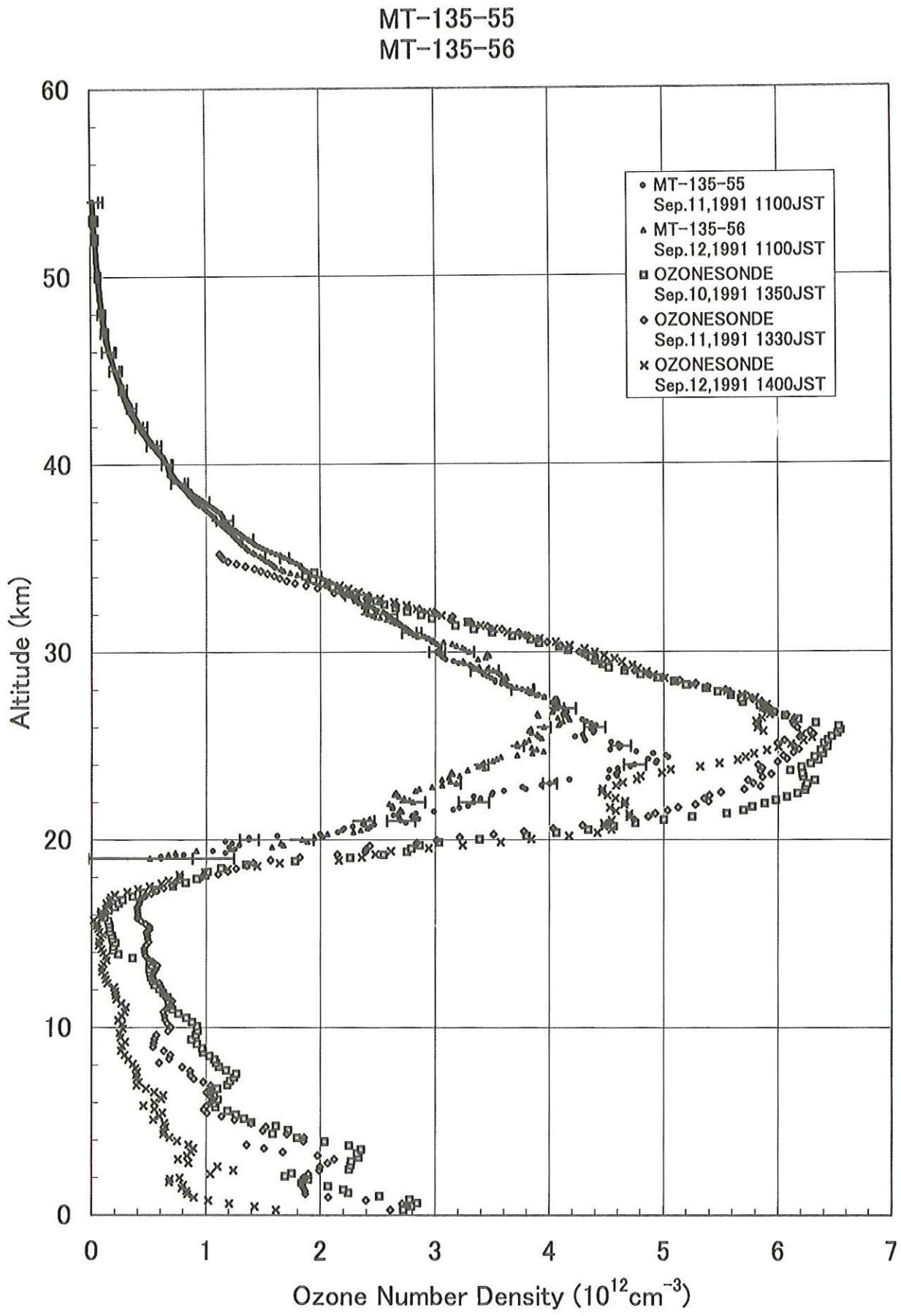
Raw data characteristics

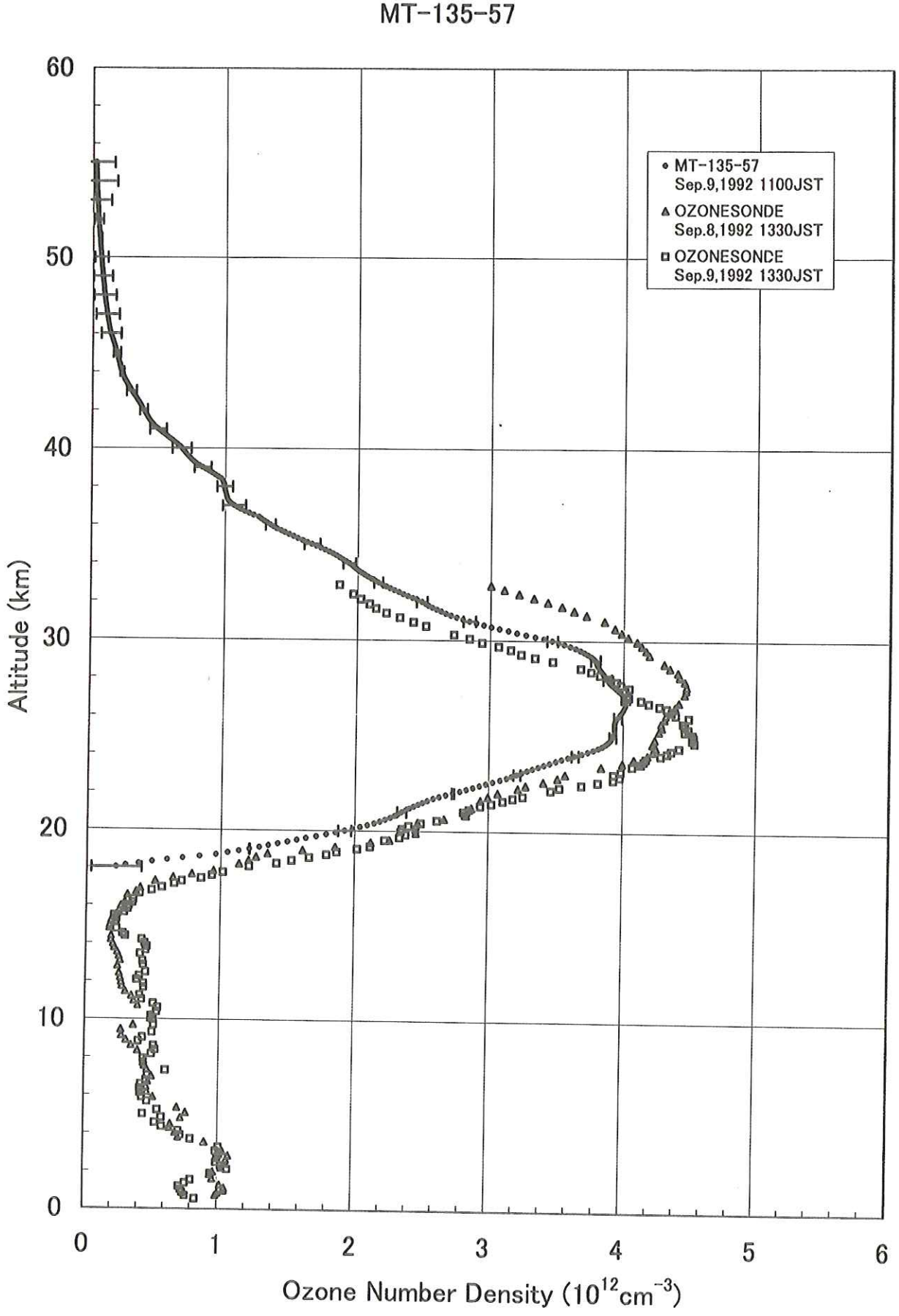
The payload descended rather fast, and it was shorter than 2 minutes to come down to 20 km. The temporal variations of the optical signal indicates slow and large coning motion of the payload. The radiometer did not receive the sunlight for more than 60% of the observation time. The data quality was not sufficient to produce ozone profiles.

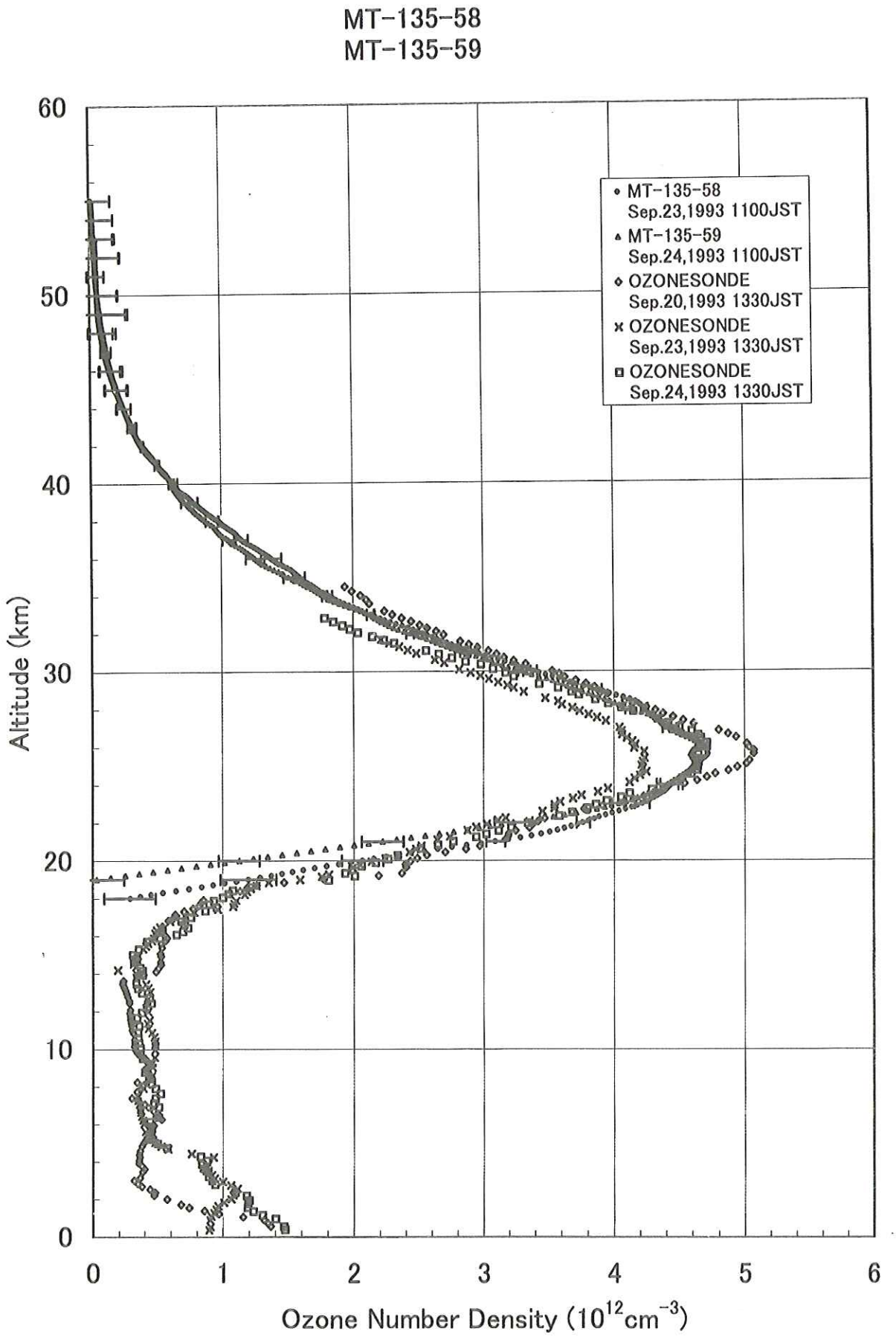
OZONE channel	λ	$\Delta\lambda$	TM (volts)	Ozone profile interval (km)
C0	266.4	11.1	1.7	N.A.
C1	289.2	11.8	1.7	N.A.
C2	299.4	13.1	2.6	N.A.
C3	306.5	11.8	2.5	N.A.
REF				
R0	420.5	11.1	3.2	
R1	421.7	11.3	3.2	
R2	420.6	11.0	3.3	
R3	420.3	11.0	3.1	



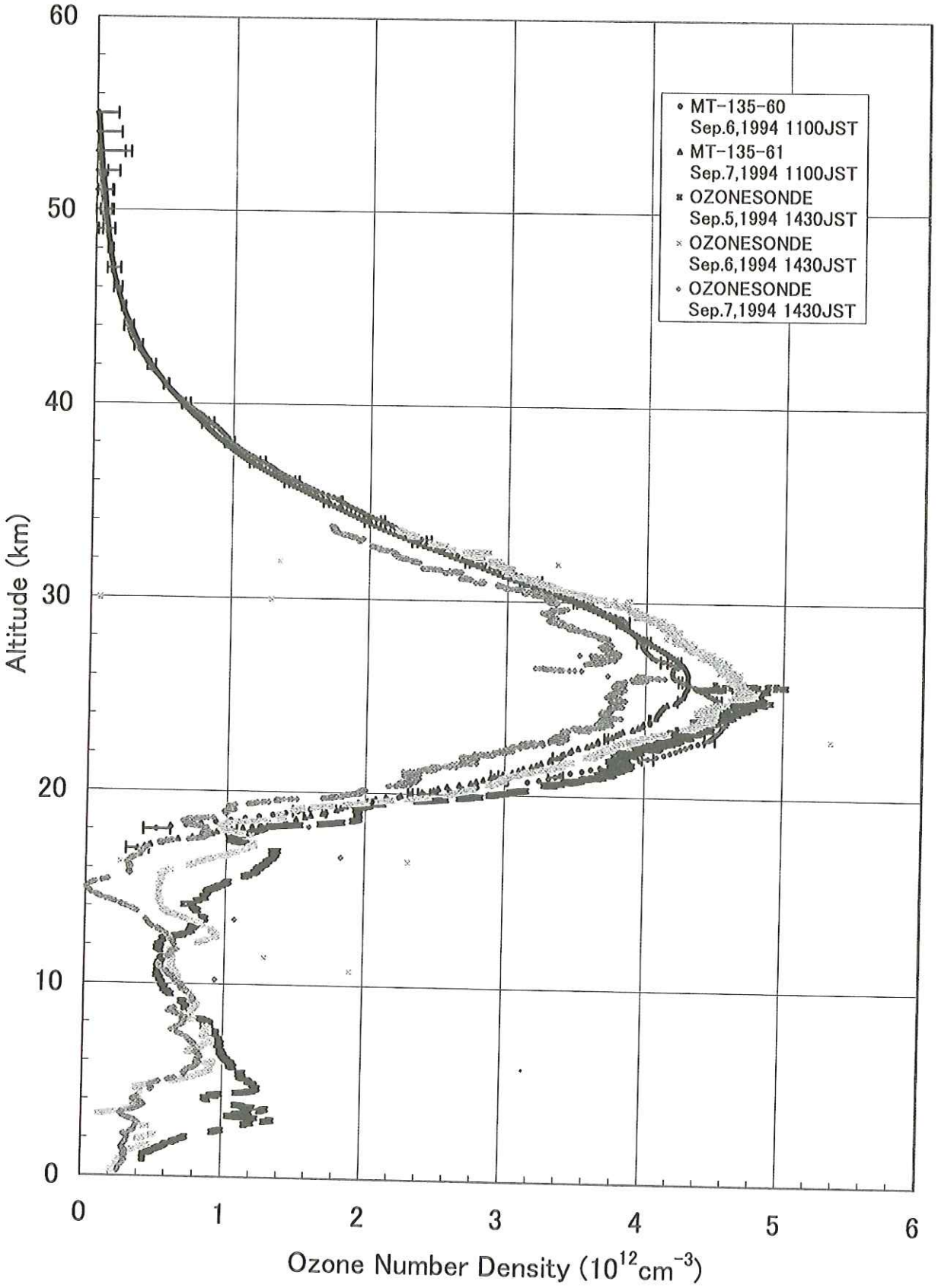


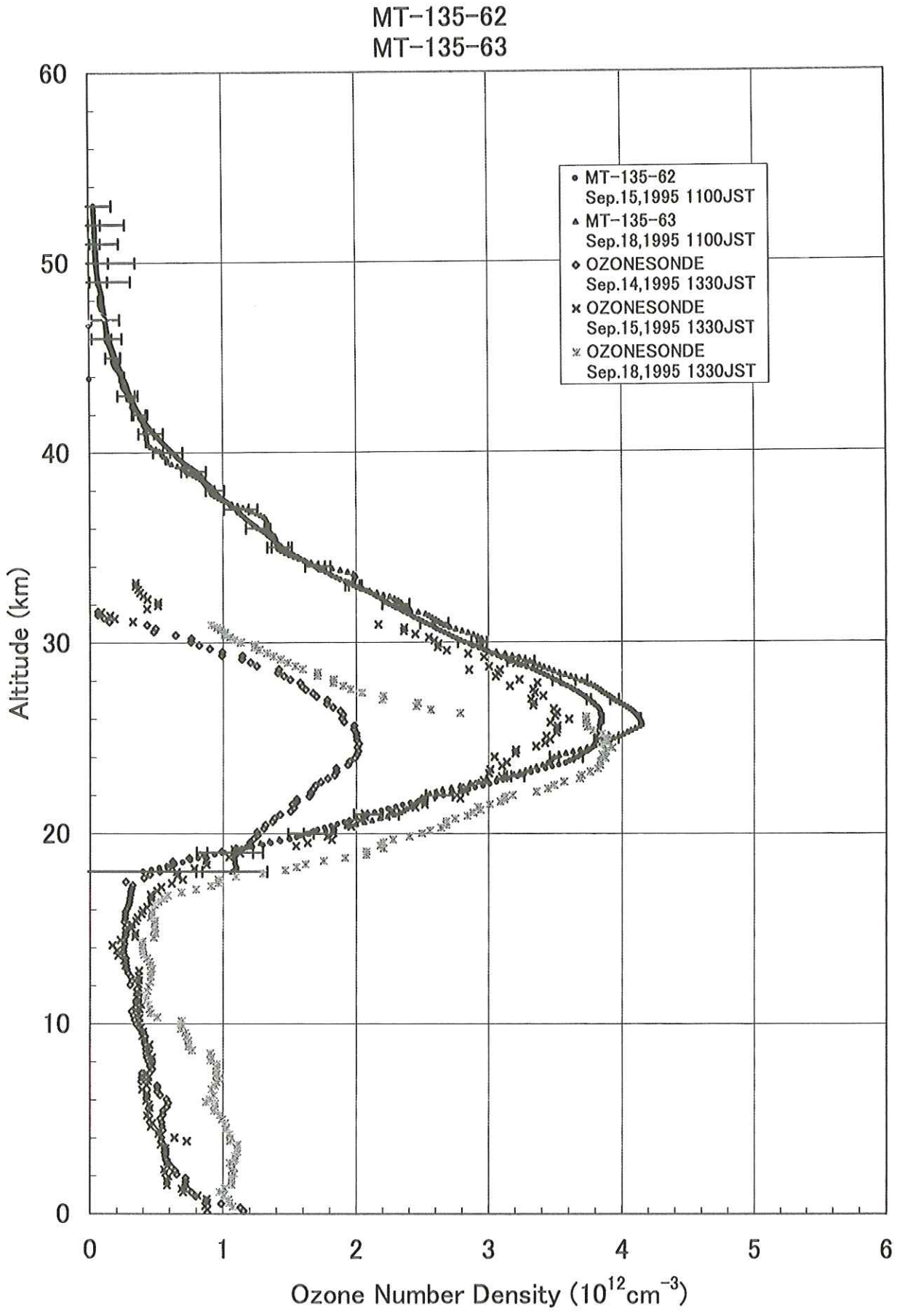


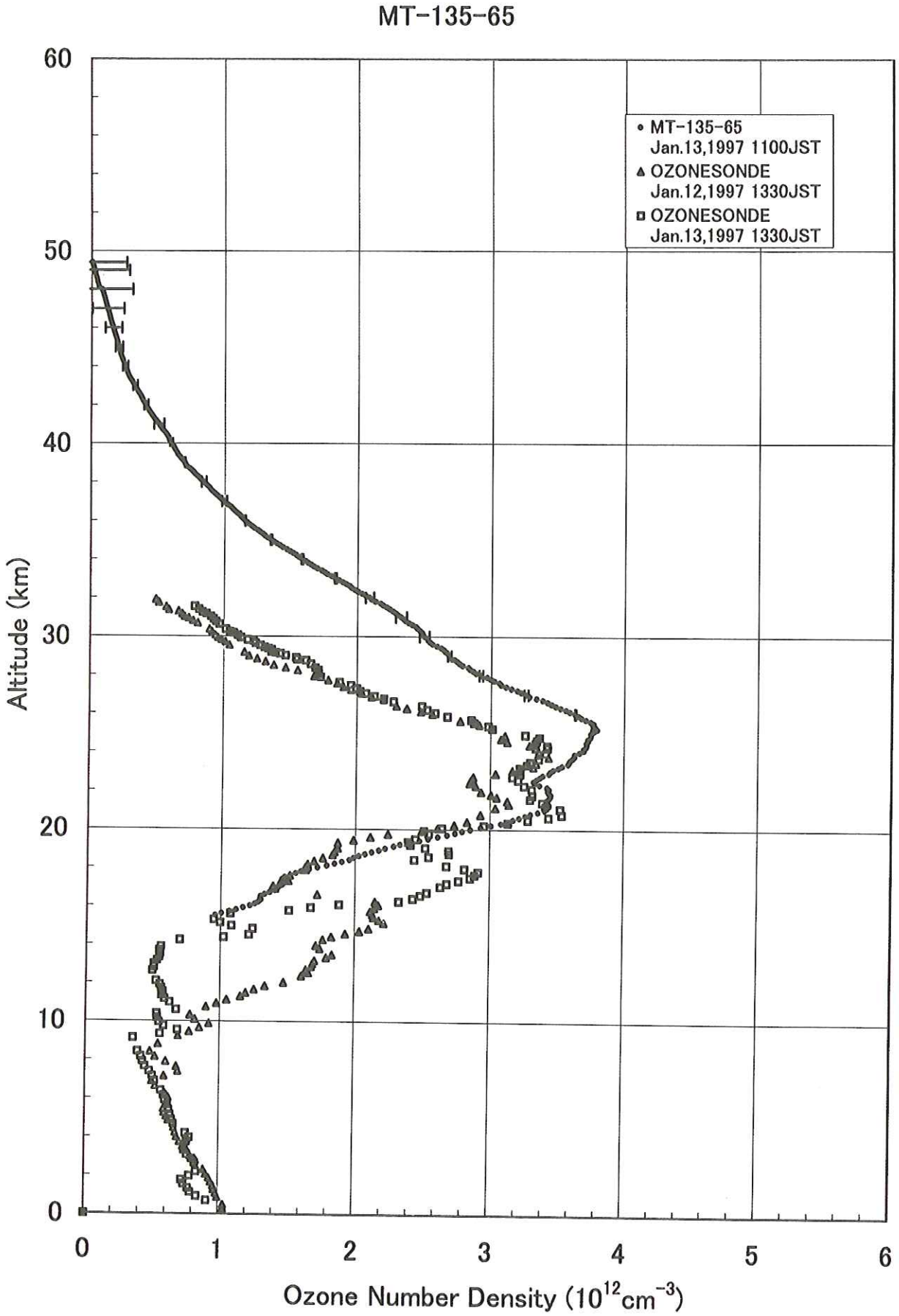


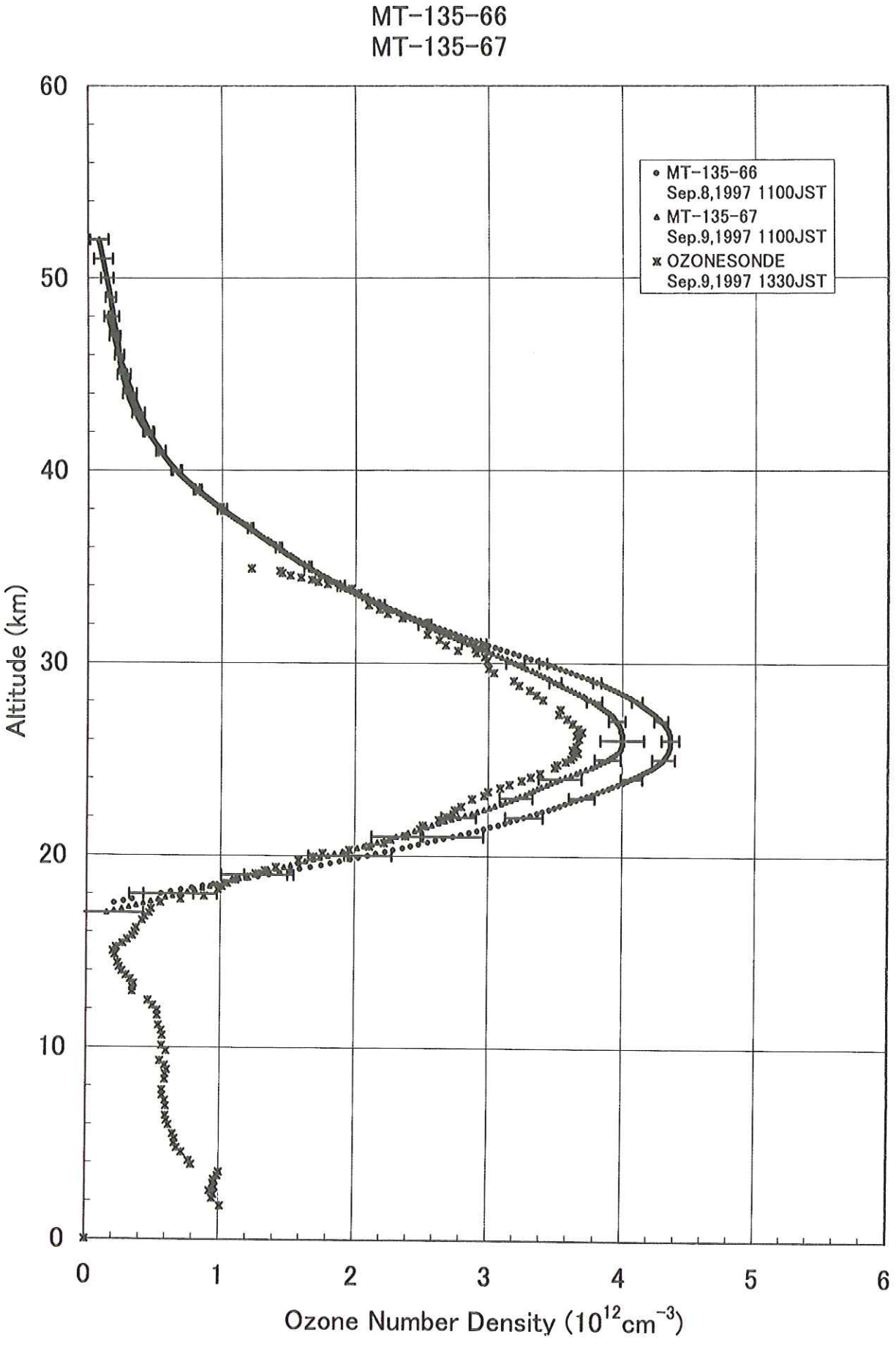


MT-135-60
MT-135-61

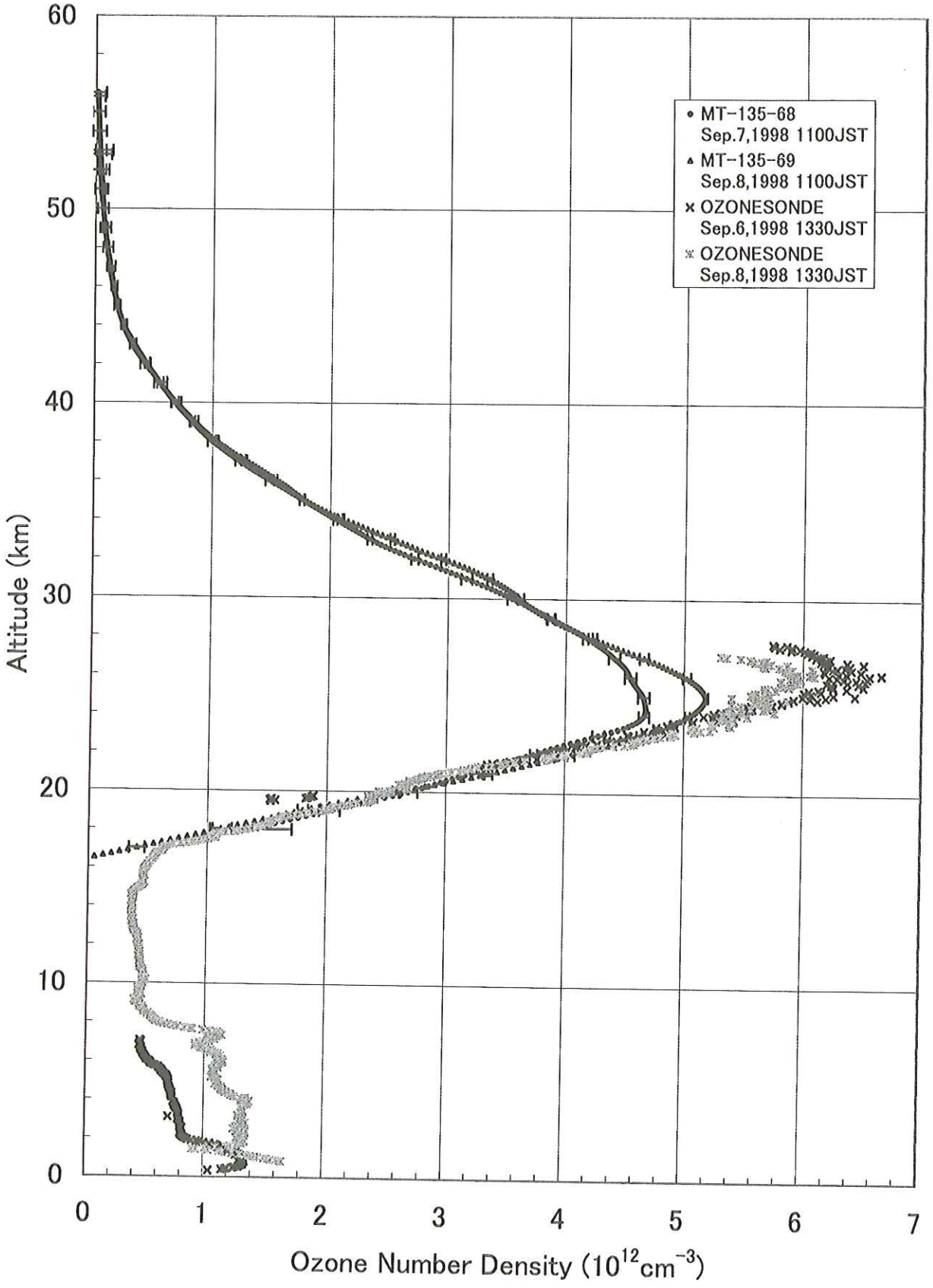








MT-135-68
MT-135-69



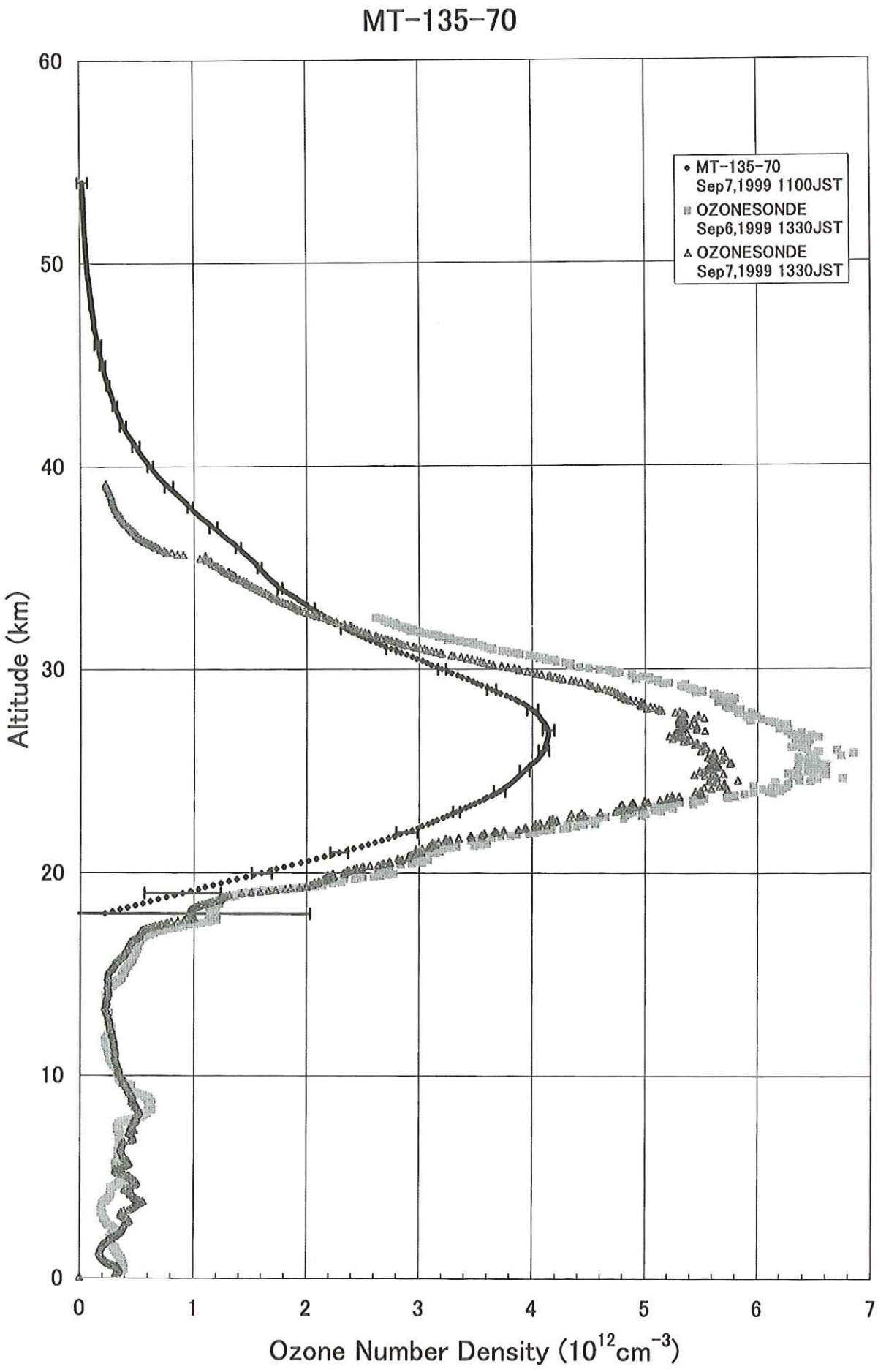


Table Ⅲ -1～21. Composite results(MT-135-52 ～ 70).The altitudes are in km, O3 densities are in molecules/cm3, errors are in %, and temperatures are in K units, respectively.

Figure4-1 ～ 11. Ozone number density profiles obtained with the rockets and ozonesondes at Uchinoura.

MT-135-52 Aug 26, 1990 1110JST
Ozonesonde Aug 26, 1990 1400JST

Altitude	O_3 Density	Estimated Error	Temperature	Ozonesonde
52	4.09E+10	6.2	264.2	
51	5.30E+10	3.8	267.0	
50	6.26E+10	3.2	262.6	
49	7.62E+10	1.9	267.8	
48	9.57E+10	4.4	270.3	
47	1.25E+11	4.3	266.2	
46	1.64E+11	3.8	262.5	
45	2.13E+11	3.3	262.9	
44	2.70E+11	2.1	256.6	
43	3.47E+11	2.7	254.3	
42	4.46E+11	3.4	250.8	
41	5.45E+11	4.1	250.3	
40	6.58E+11	3.1	252.6	
39	8.07E+11	4.7	249.6	
38	9.82E+11	3.0	249.8	
37	1.14E+12	4.6	242.4	
36	1.30E+12	2.9	239.4	
35	1.55E+12	2.3	240.3	
34	1.82E+12	2.7	239.1	
33	2.11E+12	3.8	234.2	
32	2.49E+12	5.9	231.8	4.69E+11
31	2.86E+12	5.4	229.8	7.71E+11
30	3.39E+12	4.4	230.3	1.10E+12
29	3.67E+12	5.1	229.3	2.22E+12
28	3.95E+12	6.1	227.0	2.24E+12
27	4.38E+12	6.3	226.0	2.97E+12
26	4.25E+12	6.0	224.8	4.23E+12
25	3.93E+12	5.6	218.1	4.58E+12
24	3.85E+12	6.3	217.6	4.60E+12
23	3.68E+12	3.8	218.0	4.27E+12
22	3.16E+12	11.9	214.8	3.92E+12
21	2.58E+12	9.9	213.8	3.26E+12
20	2.17E+12	11.2	211.1	3.12E+12
19	1.48E+12	32.1	206.1	2.22E+12
18	5.12E+11	27.0	204.3	1.55E+12
17			202.6	6.41E+11
16			202.1	4.75E+11
15			206.2	4.64E+11
14			213.0	4.09E+11
13			217.5	3.48E+11
12			222.1	2.61E+11
11			230.0	2.68E+11
10			238.0	3.09E+11
9			244.8	4.95E+11
8			253.9	4.46E+11
7			261.8	3.19E+11
6			269.2	3.57E+11
5			275.4	8.72E+11
4				1.53E+12
3				1.10E+12
2				5.75E+11
1				1.22E+12
0				

MT-135-53 Feb 9, 1991 1100JST
Ozonesonde Feb 9, 1991 1400JST

Altitude	O_3 Density	Estimated Error	Temperature	Ozonesonde
52	3.46E+10	6.7	263.6	
51	3.47E+10	6.0	264.0	
50	3.93E+10	5.9	260.1	
49	6.14E+10	3.5	267.0	
48	8.05E+10	4.6	261.9	
47	1.02E+11	5.2	261.8	
46	1.46E+11	5.1	257.3	
45	1.91E+11	5.4	254.8	
44	2.25E+11	3.3	250.4	
43	3.10E+11	4.2	250.0	
42	3.76E+11	5.6	249.1	
41	3.96E+11	5.6	249.2	
40	4.53E+11	5.0	248.8	
39	6.27E+11	4.4	246.5	
38	7.54E+11	4.9	244.5	
37	8.51E+11	4.1	244.5	
36	9.60E+11	3.5	244.5	
35	1.09E+12	4.8	229.7	8.55E+11
34	1.24E+12	4.3	229.7	1.14E+12
33	1.37E+12	1.4	229.7	1.31E+12
32	1.50E+12	4.0	230.1	1.56E+12
31	1.66E+12	8.0	228.5	1.86E+12
30	2.27E+12	8.5	223.5	2.22E+12
29	2.59E+12	9.9	223.3	2.65E+12
28	2.67E+12	10.5	224.0	2.80E+12
27	3.08E+12	9.7	220.8	3.08E+12
26	3.49E+12	9.2	219.8	3.59E+12
25	3.80E+12	6.0	217.5	4.02E+12
24	4.03E+12	12.1	216.8	4.57E+12
23	4.39E+12	7.6	216.7	4.73E+12
22	4.19E+12	16.3	212.9	5.21E+12
21	2.78E+12	15.0	205.2	3.90E+12
20	1.37E+12	10.1	203.0	2.44E+12
19	7.46E+11	77.0	203.5	1.48E+12
18	4.72E+10	15.5	201.1	8.23E+11
17			200.8	4.85E+11
16			203.8	3.94E+11
15			208.4	3.70E+11
14			213.7	3.84E+11
13			218.0	3.70E+11
12			225.3	3.06E+11
11			230.9	4.41E+11
10			235.7	5.92E+11
9			237.4	4.95E+11
8			237.8	5.90E+11
7			243.8	5.84E+11
6			251.4	6.29E+11
5			254.5	6.47E+11
4				7.15E+11
3				8.24E+11
2				1.04E+12
1				1.08E+12
0				

MT-135-54 Feb 11, 1991 1100JST
Ozonesonde Feb 9, 1991 1400JST

Altitude	O_3 Density	Estimated Error	Temperature	Ozonesonde
57	3.58E+09	19.0	255.7	
56	7.29E+09	4.7	254.9	
55	1.16E+10	6.2	257.8	
54	1.61E+10	7.4	259.9	
53	1.96E+10	8.4	265.9	
52	2.37E+10	3.1	261.1	
51	3.06E+10	4.9	263.1	
50	4.14E+10	4.9	264.3	
49	6.36E+10	2.9	262.0	
48	8.68E+10	3.8	264.3	
47	1.10E+11	4.3	262.5	
46	1.39E+11	4.2	263.7	
45	1.88E+11	4.5	255.6	
44	2.59E+11	2.7	253.6	
43	3.24E+11	3.5	250.7	
42	4.12E+11	4.6	245.8	
41	4.72E+11	4.6	245.3	
40	5.72E+11	4.2	245.6	
39	7.59E+11	3.6	242.5	
38	8.93E+11	4.0	241.8	
37	1.02E+12	3.4	241.2	
36	1.12E+12	2.9	241.0	
35	1.26E+12	4.0	236.9	8.55E+11
34	1.47E+12	3.6	235.9	1.14E+12
33	1.59E+12	1.2	233.8	1.31E+12
32	1.70E+12	3.3	231.5	1.56E+12
31	1.93E+12	6.6	225.5	1.86E+12
30	2.41E+12	7.0	224.2	2.22E+12
29	3.05E+12	8.2	223.9	2.65E+12
28	3.22E+12	8.7	221.9	2.80E+12
27	3.54E+12	8.0	220.5	3.08E+12
26	4.31E+12	7.6	219.9	3.59E+12
25	4.45E+12	4.9	219.8	4.02E+12
24	4.28E+12	10.0	216.8	4.57E+12
23	4.58E+12	6.2	216.1	4.73E+12
22	3.80E+12	13.4	212.4	5.21E+12
21	2.66E+12	12.4	211.7	3.90E+12
20	2.16E+12	8.3	207.5	2.44E+12
19	1.40E+12	63.6	205.3	1.48E+12
18	7.14E+11	21.0	203.9	8.23E+11
17	5.35E+09	12.8	204.9	4.85E+11
16			203.6	3.94E+11
15			207.0	3.70E+11
14			211.0	3.84E+11
13			214.6	3.70E+11
12			220.8	3.06E+11
11			226.8	4.41E+11
10			231.4	5.92E+11
9			235.1	4.95E+11
8				5.90E+11
7				5.84E+11
6				6.29E+11
5				6.47E+11
4				7.15E+11
3				8.24E+11
2				1.04E+12
1				1.08E+12
0				

MT-135-55 Sep 11, 1991 1100JST
Ozonesonde Sep 11,1991 1330JST

Altitude	O_3 Density	Estimated Error	Temperature	Ozonesonde
54	2.12E+10	8.9	271.0	
53	2.93E+10	3.8	269.7	
52	3.80E+10	3.1	269.0	
51	4.71E+10	1.8	267.1	
50	6.15E+10	2.8	269.5	
49	7.70E+10	1.8	270.6	
48	9.34E+10	3.7	269.2	
47	1.19E+11	3.5	271.3	
46	1.56E+11	6.1	273.1	
45	2.12E+11	5.4	260.6	
44	2.74E+11	3.6	257.5	
43	3.50E+11	4.4	255.6	
42	4.37E+11	5.5	254.8	
41	5.48E+11	6.5	255.4	
40	6.63E+11	5.1	253.3	
39	7.72E+11	7.5	248.6	
38	9.82E+11	4.9	247.5	
37	1.17E+12	7.3	247.0	
36	1.37E+12	4.8	245.5	
35	1.69E+12	3.9	239.7	1.15E+12
34	1.96E+12	4.5	233.1	1.60E+12
33	2.27E+12	6.1	231.7	2.20E+12
32	2.58E+12	9.2	231.6	3.00E+12
31	2.79E+12	8.5	234.8	3.73E+12
30	3.01E+12	6.9	233.4	4.26E+12
29	3.39E+12	8.1	230.6	4.75E+12
28	3.76E+12	9.6	230.6	5.54E+12
27	4.13E+12	9.9	228.9	5.93E+12
26	4.39E+12	9.5	228.0	6.17E+12
25	4.63E+12	8.8	225.2	6.14E+12
24	4.75E+12	9.9	224.8	5.83E+12
23	4.01E+12	6.1	223.7	5.78E+12
22	3.34E+12	13.3	221.5	5.39E+12
21	2.70E+12	12.3	219.2	4.74E+12
20	1.38E+12	8.2	211.0	3.01E+12
19	6.07E+11	63.5	206.5	1.82E+12
18	2.66E+12	12.4	203.8	9.63E+11
17	2.16E+12	8.3	201.0	4.62E+11
16	1.40E+12	63.6	204.1	4.01E+11
15	7.14E+11	21.0	209.0	4.76E+11
14	5.35E+09	12.8	214.2	4.62E+11
13			220.5	5.43E+11
12			227.0	6.21E+11
11			235.2	6.58E+11
10			242.6	6.95E+11
9			251.0	5.36E+11
8			257.5	7.93E+11
7			265.2	1.04E+12
6			271.6	1.04E+12
5			276.9	1.25E+12
4				1.85E+12
3				2.12E+12
2				1.85E+12
1				2.07E+12
0				

MT-135-56 Sep 12, 1991 1100JST
Ozonesonde Sep 12,1991 1400JST

Altitude	O_3 Density	Estimated Error	Temperature	Ozonesonde
54	1.78E+10	5.4	261.3	
53	2.79E+10	2.4	261.2	
52	3.90E+10	2.0	264.9	
51	5.16E+10	1.2	264.1	
50	6.62E+10	1.8	265.6	
49	8.24E+10	1.2	267.2	
48	1.03E+11	2.3	266.0	
47	1.30E+11	2.2	266.0	
46	1.65E+11	3.7	262.4	
45	2.11E+11	3.3	260.4	
44	2.62E+11	2.3	263.4	
43	3.23E+11	2.7	258.4	
42	4.17E+11	3.4	252.6	
41	5.34E+11	4.0	249.7	
40	6.66E+11	3.1	249.2	
39	7.73E+11	4.6	246.7	
38	9.12E+11	3.0	242.5	
37	1.10E+12	4.4	242.2	
36	1.27E+12	3.0	239.6	
35	1.49E+12	2.4	231.9	
34	1.86E+12	2.8	230.1	2.05E+12
33	2.25E+12	3.7	229.7	2.40E+12
32	2.41E+12	5.6	230.6	3.05E+12
31	2.78E+12	5.2	231.2	3.63E+12
30	3.29E+12	4.2	230.4	4.40E+12
29	3.50E+12	4.9	228.1	4.85E+12
28	3.81E+12	5.8	229.7	5.38E+12
27	4.07E+12	6.0	227.4	5.87E+12
26	3.95E+12	5.7	223.2	5.82E+12
25	3.72E+12	5.3	221.7	6.00E+12
24	3.40E+12	6.0	223.4	5.49E+12
23	3.18E+12	3.8	220.9	4.64E+12
22	2.80E+12	10.9	218.6	4.66E+12
21	2.37E+12	9.1	219.2	4.55E+12
20	1.84E+12	10.3	212.3	3.84E+12
19	5.07E+11	37.4	205.2	2.36E+12
18	2.66E+12	12.4	202.1	7.72E+11
17	2.16E+12	8.3	198.5	2.00E+11
16	1.40E+12	63.6	201.7	7.54E+10
15	7.14E+11	21.0	205.9	9.68E+10
14	5.35E+09	12.8	212.3	9.97E+10
13			219.0	9.03E+10
12			227.6	2.01E+11
11			232.5	2.95E+11
10			240.3	2.69E+11
9			247.9	2.61E+11
8			253.5	3.56E+11
7			260.7	3.89E+11
6			267.3	5.48E+11
5			272.5	5.39E+11
4				7.48E+11
3				7.56E+11
2				7.72E+11
1				8.96E+11
0				

MT-135-57 Sep 9, 1992 1100JST
Ozonesonde Sep 9, 1992 1330JST

Altitude	O_3 Density	Estimated Error	Temperature	Ozonesonde
55	2.18E+10	14.4	274.5	
54	2.71E+10	15.8	273.3	
53	3.37E+10	10.6	267.7	
52	4.20E+10	3.5	268.5	
51	5.15E+10	1.5	274.6	
50	6.26E+10	5.1	271.6	
49	7.56E+10	7.3	273.8	
48	9.12E+10	8.6	270.2	
47	1.11E+11	9.0	270.7	
46	1.39E+11	7.6	273.4	
45	1.84E+11	2.7	267.8	
44	2.21E+11	1.6	259.0	
43	2.93E+11	3.7	256.2	
42	3.86E+11	3.0	258.3	
41	4.94E+11	6.1	251.7	
40	6.73E+11	7.3	248.7	
39	8.30E+11	6.1	245.5	
38	9.95E+11	5.8	245.3	
37	1.07E+12	8.5	240.6	
36	1.34E+12	3.9	238.2	
35	1.65E+12	6.0	236.7	
34	1.94E+12	4.8	237.3	
33	2.15E+12	3.4	235.0	1.86E+12
32	2.48E+12	4.1	234.7	2.09E+12
31	2.84E+12	4.7	231.7	2.42E+12
30	3.47E+12	4.0	230.5	2.84E+12
29	3.79E+12	3.4	230.3	3.47E+12
28	3.88E+12	3.1	228.4	3.90E+12
27	4.02E+12	3.2	223.4	4.04E+12
26	3.96E+12	3.0	221.3	4.49E+12
25	3.92E+12	2.7	219.6	4.53E+12
24	3.64E+12	2.5	219.3	4.28E+12
23	3.21E+12	2.6	218.0	3.93E+12
22	2.73E+12	0.9	213.0	3.26E+12
21	2.35E+12	3.4	212.4	2.81E+12
20	1.92E+12	5.0	210.1	2.34E+12
19	1.21E+12	0.3	207.2	2.02E+12
18	2.20E+11	19.0	202.7	1.21E+12
17			199.2	5.61E+11
16			202.0	3.18E+11
15			205.6	2.20E+11
14			212.7	4.40E+11
13			218.1	4.25E+11
12			225.2	3.81E+11
11			234.2	4.21E+11
10			242.8	5.11E+11
9			250.2	4.33E+11
8			256.4	4.42E+11
7			263.5	4.73E+11
6			268.9	4.18E+11
5			276.6	4.41E+11
4			282.9	7.23E+11
3			287.5	9.86E+11
2			291.5	1.07E+12
1			296.0	7.28E+11
0				

MT-135-58 Sep 23, 1993 1100JST
Ozonesonde Sep 23, 1993 1330JST

Altitude	O_3 Density	Estimated Error	Temperature	Ozonesonde
55	1.51E+10	14.7	265.9	
54	2.22E+10	16.1	265.5	
53	2.97E+10	15.2	268.3	
52	3.86E+10	18.6	262.5	
51	4.63E+10	6.4	261.9	
50	5.89E+10	15.6	264.0	
49	7.83E+10	21.1	263.6	
48	1.01E+11	9.9	265.7	
47	1.30E+11	3.2	262.1	
46	1.62E+11	8.5	259.9	
45	2.02E+11	8.6	256.1	
44	2.54E+11	5.6	253.6	
43	3.13E+11	3.1	253.6	
42	3.87E+11	0.5	252.4	
41	5.11E+11	1.8	250.9	
40	6.42E+11	2.6	248.4	
39	7.86E+11	3.2	245.6	
38	9.80E+11	0.4	241.0	
37	1.15E+12	4.8	238.2	
36	1.38E+12	7.5	235.3	
35	1.59E+12	4.0	236.2	
34	1.82E+12	1.8	233.1	
33	2.14E+12	3.0	232.2	
32	2.53E+12	3.2	233.5	
31	2.93E+12	2.2	232.1	2.49E+12
30	3.39E+12	2.3	228.7	2.90E+12
29	3.87E+12	3.6	226.7	3.31E+12
28	4.23E+12	2.7	229.3	3.69E+12
27	4.46E+12	3.6	228.0	4.04E+12
26	4.69E+12	2.4	222.7	4.15E+12
25	4.62E+12	2.0	220.7	4.21E+12
24	4.44E+12	8.4	220.1	4.12E+12
23	4.22E+12	5.8	217.9	3.55E+12
22	3.77E+12	5.0	216.5	3.03E+12
21	3.09E+12	7.3	212.7	2.64E+12
20	2.07E+12	15.8	209.5	2.14E+12
19	1.20E+12	21.2	207.6	1.59E+12
18	2.86E+11	19.9	204.6	1.10E+12
17			199.8	6.44E+11
16			200.6	4.70E+11
15			204.9	3.48E+11
14			207.9	3.35E+11
13			214.6	4.42E+11
12			222.1	4.26E+11
11			230.4	4.29E+11
10			238.1	4.79E+11
9			245.4	4.62E+11
8			253.4	3.91E+11
7			259.0	3.56E+11
6				3.92E+11
5				4.78E+11
4				8.88E+11
3				1.00E+12
2				1.06E+12
1				9.12E+11
0				

MT-135-59 Sep 24, 1993 1100JST
Ozonesonde Sep 24, 1993 1330JST

Altitude	O_3 Density	Estimated Error	Temperature	Ozonesonde
55	1.81E+10	14.4	274.1	
54	2.43E+10	15.8	262.0	
53	4.45E+10	15.0	260.5	
52	4.75E+10	18.3	260.1	
51	5.15E+10	6.0	263.3	
50	5.57E+10	15.3	263.6	
49	6.38E+10	20.9	265.1	
48	8.26E+10	9.6	264.4	
47	1.08E+11	2.8	262.8	
46	1.49E+11	8.2	261.0	
45	1.95E+11	8.3	263.2	
44	2.57E+11	5.2	255.9	
43	3.29E+11	2.7	248.6	
42	4.07E+11	0.1	248.1	
41	5.19E+11	0.4	248.3	
40	6.21E+11	2.2	246.2	
39	7.23E+11	2.8	240.4	
38	8.79E+11	0.0	242.3	
37	1.06E+12	4.4	240.3	
36	1.26E+12	7.2	239.6	
35	1.51E+12	3.6	237.8	
34	1.78E+12	1.4	236.6	
33	2.13E+12	2.7	235.2	1.78E+12
32	2.44E+12	2.9	232.5	2.04E+12
31	2.84E+12	1.8	232.8	2.56E+12
30	3.29E+12	2.0	233.5	3.17E+12
29	3.72E+12	3.2	231.4	3.58E+12
28	4.11E+12	2.4	230.7	4.06E+12
27	4.41E+12	3.2	230.9	4.50E+12
26	4.65E+12	2.1	225.2	4.71E+12
25	4.63E+12	1.6	224.4	4.64E+12
24	4.41E+12	8.0	221.8	4.48E+12
23	4.04E+12	5.4	221.7	3.86E+12
22	3.23E+12	14.7	218.2	3.34E+12
21	2.22E+12	16.1	215.0	2.77E+12
20	1.12E+12	15.5	214.3	2.26E+12
19	2.85E+10	21.0	210.7	1.81E+12
18			208.4	1.00E+12
17			205.8	7.54E+11
16			206.0	6.45E+11
15			207.9	3.04E+11
14			212.7	3.84E+11
13			218.7	3.75E+11
12			224.0	3.76E+11
11				3.47E+11
10				3.67E+11
9				4.34E+11
8				4.83E+11
7				5.08E+11
6				4.51E+11
5				4.99E+11
4				8.75E+11
3				9.15E+11
2				1.20E+12
1				1.40E+12
0				

MT-135-60 Sep 6, 1994 1100JST
Ozonesonde Sep 6, 1994 1430JST

Altitude	O_3 Density	Estimated Error	Temperature	Ozonesonde
53	2.32E+10	22.4	265.5	
52	3.26E+10	13.4	262.6	
51	4.19E+10	7.9	268.3	
50	5.29E+10	5.4	267.6	
49	7.38E+10	5.9	263.5	
48	1.03E+11	1.3	264.7	
47	1.31E+11	5.0	256.4	
46	1.59E+11	0.6	254.3	
45	2.02E+11	0.9	255.3	
44	2.41E+11	3.4	254.2	
43	2.98E+11	1.8	259.4	
42	3.92E+11	1.4	256.4	
41	5.15E+11	1.7	258.9	
40	6.61E+11	2.8	250.8	
39	8.41E+11	1.8	240.3	
38	9.91E+11	1.8	237.3	
37	1.21E+12	1.9	234.1	
36	1.47E+12	1.5	235.3	
35	1.79E+12	0.6	236.1	
34	2.09E+12	1.4	235.8	
33	2.43E+12	1.8	233.3	2.45E+12
32	2.79E+12	2.1	227.3	2.88E+12
31	3.23E+12	1.8	226.9	3.22E+12
30	3.52E+12	2.6	227.0	6.60E+12
29	3.85E+12	2.4	223.9	4.04E+12
28	3.96E+12	2.9	225.4	4.33E+12
27	4.13E+12	2.4	225.3	4.58E+12
26	4.25E+12	1.3	221.6	4.66E+12
25	4.53E+12	1.9	216.0	4.62E+12
24	4.57E+12	2.6	213.9	4.44E+12
23	4.47E+12	3.7	212.9	3.99E+12
22	4.02E+12	4.3	212.8	3.63E+12
21	3.36E+12	5.2	212.8	3.02E+12
20	2.43E+12	4.4	207.8	2.60E+12
19	1.52E+12	3.9	204.3	1.48E+12
18	5.02E+11	9.7	200.3	9.87E+11
17			200.8	1.12E+12
16			201.6	6.08E+11
15			200.4	5.28E+11
14			205.4	5.49E+11
13			213.3	8.51E+11
12			220.9	8.00E+11
11			228.7	6.30E+11
10			237.3	7.00E+11
9			245.6	8.09E+11
8			255.0	7.45E+11
7			260.4	9.22E+11
6			266.5	9.30E+11
5			273.5	6.81E+11
4			279.4	3.71E+11
3			285.7	1.17E+11
2			291.3	4.46E+11
1			294.3	2.88E+11
0				

MT-135-61 Sep 7, 1994 1100JST
Ozonesonde Sep 7, 1994 1430JST

Altitude	O_3 Density	Estimated Error	Temperature	Ozonesonde
55	1.05E+10	14.4	276.9	
54	2.11E+10	15.8	265.9	
53	3.14E+10	17.1	272.8	
52	4.51E+10	2.9	268.6	
51	5.99E+10	5.3	266.0	
50	7.21E+10	7.2	266.1	
49	8.81E+10	4.4	265.1	
48	1.04E+11	2.0	262.4	
47	1.26E+11	1.6	262.4	
46	1.60E+11	3.2	266.9	
45	2.04E+11	1.7	265.9	
44	2.63E+11	1.4	257.9	
43	3.27E+11	1.4	254.0	
42	4.15E+11	2.4	251.1	
41	5.19E+11	1.8	251.3	
40	6.40E+11	1.5	251.5	
39	7.87E+11	1.3	248.1	
38	9.41E+11	0.6	244.9	
37	1.13E+12	1.6	241.2	
36	1.39E+12	1.8	238.7	
35	1.68E+12	2.0	236.1	
34	1.98E+12	1.9	235.4	1.72E+12
33	2.33E+12	1.9	235.0	1.93E+12
32	2.71E+12	1.6	232.3	2.32E+12
31	3.10E+12	1.3	231.5	2.81E+12
30	3.48E+12	1.2	229.9	3.30E+12
29	3.79E+12	1.1	228.9	3.34E+12
28	4.02E+12	1.2	228.3	3.73E+12
27	4.24E+12	1.1	227.3	3.72E+12
26	4.31E+12	0.7	226.4	3.94E+12
25	4.23E+12	0.1	220.7	3.82E+12
24	4.04E+12	0.7	219.8	3.72E+12
23	3.72E+12	1.4	216.2	3.44E+12
22	3.37E+12	3.1	215.8	2.69E+12
21	2.93E+12	2.8	214.5	2.39E+12
20	2.32E+12	1.7	211.9	1.97E+12
19	1.72E+12	3.7	208.2	1.01E+12
18	1.03E+12	3.9	205.3	8.72E+11
17	3.66E+11	8.2	204.7	4.18E+11
16			205.8	3.08E+11
15			209.1	6.87E+09
14			214.9	2.90E+11
13			218.3	4.73E+11
12			224.0	6.45E+11
11			231.9	5.42E+11
10			240.2	6.76E+11
9			247.5	7.74E+11
8			254.5	7.14E+11
7			261.4	7.79E+11
6			268.1	8.19E+11
5			274.6	6.12E+11
4			280.2	3.71E+11
3			287.4	3.37E+11
2			291.8	3.26E+11
1			298.5	3.04E+11
0				

MT-135-62 Sep 15, 1995 1100JST
Ozonesonde Sep 15, 1995 1330JST

Altitude	O_3 Density	Estimated Error	Temperature	Ozonesonde
53	3.81E+10	13.0		
52	4.38E+10	4.4		
51	4.83E+10	3.6		
50	5.46E+10	9.1		
49	7.46E+10	6.5	262.0	
48	1.01E+11	1.2	262.4	
47	1.22E+11	0.4	262.1	
46	1.50E+11	1.9	261.1	
45	1.97E+11	3.3	258.8	
44	2.54E+11	0.2	256.2	
43	3.11E+11	3.2	254.6	
42	3.78E+11	4.5	255.0	
41	4.87E+11	6.6	247.2	
40	6.27E+11	7.3	241.5	
39	8.01E+11	7.2	240.3	
38	9.39E+11	7.1	240.1	
37	1.10E+12	9.2	240.5	
36	1.26E+12	8.9	236.0	
35	1.44E+12	7.5	232.3	
34	1.69E+12	7.4	230.8	
33	1.98E+12	6.2	229.8	3.42E+11
32	2.25E+12	5.3	228.4	5.12E+11
31	2.53E+12	4.8	230.3	2.17E+12
30	2.82E+12	5.1	227.7	2.59E+12
29	3.18E+12	3.9	228.4	3.18E+12
28	3.51E+12	3.0	226.8	3.23E+12
27	3.75E+12	1.7	225.1	3.32E+12
26	3.85E+12	1.3	224.1	3.60E+12
25	3.82E+12	3.1	225.1	3.44E+12
24	3.67E+12	3.3	223.1	3.04E+12
23	3.22E+12	4.9	219.3	3.10E+12
22	2.66E+12	6.8	213.0	2.76E+12
21	2.09E+12	10.8	212.1	2.06E+12
20	1.63E+12	14.5	211.1	1.83E+12
19	1.01E+12	21.2	206.7	1.13E+12
18	4.01E+11	43.9	201.5	6.53E+11
17			199.5	5.04E+11
16			201.8	3.96E+11
15			205.1	3.12E+11
14			210.4	2.00E+11
13			218.4	2.61E+11
12			226.3	3.66E+11
11			233.2	3.87E+11
10			240.4	3.70E+11
9			248.8	4.48E+11
8			256.0	4.64E+11
7			261.1	4.38E+11
6			268.4	4.23E+11
5			273.3	4.47E+11
4			278.2	6.38E+11
3				5.70E+11
2				5.94E+11
1				8.08E+11
0				

MT-135-63 Sep 18, 1995 1100JST
Ozonesonde Sep 18, 1995 1330JST

Altitude	O_3 Density	Estimated Error	Temperature	Ozonesonde
52	4.37E+10	22.4		
51	5.12E+10	16.9		
50	5.88E+10	28.9		
49	6.54E+10	24.5	269.6	
48	8.87E+10	2.0	264.3	
47	1.22E+11	10.4	269.1	
46	1.31E+11	11.2	270.3	
45	1.78E+11	5.7	269.8	
44	2.44E+11	1.9	262.4	
43	2.87E+11	7.6	254.5	
42	3.77E+11	6.0	254.0	
41	4.27E+11	5.9	255.8	
40	5.43E+11	6.4	250.9	
39	7.30E+11	4.1	244.4	
38	9.07E+11	3.2	237.1	
37	1.18E+12	7.7	237.5	
36	1.33E+12	2.4	240.8	
35	1.41E+12	7.9	235.0	
34	1.76E+12	4.6	231.8	
33	1.99E+12	4.0	232.1	
32	2.35E+12	5.6	228.8	
31	2.65E+12	5.2	227.6	9.11E+11
30	2.95E+12	3.7	228.1	1.13E+12
29	3.31E+12	3.4	227.7	1.48E+12
28	3.69E+12	4.4	225.0	1.83E+12
27	3.94E+12	3.3	225.3	2.20E+12
26	4.14E+12	0.8	224.3	3.73E+12
25	3.94E+12	3.8	223.3	3.89E+12
24	3.49E+12	3.4	220.7	3.88E+12
23	3.13E+12	1.0	218.5	3.70E+12
22	2.53E+12	0.3	216.2	3.18E+12
21	2.28E+12	3.5	216.9	2.84E+12
20	1.64E+12	3.7	211.3	2.49E+12
19	1.09E+12	20.9	208.7	2.08E+12
18	1.06E+12	26.8	205.0	1.46E+12
17			203.7	6.87E+11
16			206.9	4.67E+11
15			210.6	4.82E+11
14			214.5	3.96E+11
13			220.7	4.68E+11
12			227.7	4.40E+11
11			232.3	4.43E+11
10			238.9	6.88E+11
9			244.6	7.39E+11
8			249.2	9.04E+11
7			253.0	9.51E+11
6			261.9	8.99E+11
5			270.7	9.93E+11
4			273.6	1.05E+12
3				1.09E+12
2				1.07E+12
1				1.00E+12
0				

MT-135-65 Jan 13, 1997 1100JST
Ozonesonde Jan 13, 1997 1330JST

Altitude	O_3 Density	Estimated Error	Temperature	Ozonesonde
49	2.19E+10	26.2	261.7	
48	8.10E+10	22.8	263.3	
47	1.23E+11	11.9	260.0	
46	1.65E+11	6.1	258.4	
45	2.06E+11	2.8	256.6	
44	2.53E+11	2.1	257.8	
43	3.28E+11	1.8	257.0	
42	4.08E+11	1.5	255.9	
41	5.04E+11	3.8	256.8	
40	5.97E+11	1.1	254.7	
39	7.01E+11	1.7	252.3	
38	8.41E+11	1.8	253.5	
37	9.97E+11	1.8	251.1	
36	1.15E+12	0.3	247.4	
35	1.35E+12	0.7	244.6	
34	1.58E+12	0.7	244.5	
33	1.83E+12	0.7	240.3	
32	2.09E+12	3.1	233.9	
31	2.32E+12	4.0	233.4	9.01E+11
30	2.50E+12	3.6	227.0	1.10E+12
29	2.69E+12	1.3	225.9	1.46E+12
28	2.92E+12	1.3	226.8	1.71E+12
27	3.26E+12	1.5	224.1	2.07E+12
26	3.63E+12	0.5	223.1	2.58E+12
25	3.75E+12	1.2	221.4	3.26E+12
24	3.67E+12	3.6	217.0	3.41E+12
23	3.45E+12	2.1	220.4	3.22E+12
22	3.43E+12	3.0	219.5	3.31E+12
21	3.41E+12	2.9	217.0	3.52E+12
20	2.86E+12	5.0	216.9	2.64E+12
19	2.22E+12	4.8	216.8	2.52E+12
18	1.72E+12	6.6	215.4	2.81E+12
17	1.44E+12	15.2	217.3	2.63E+12
16	1.22E+12	21.9	218.0	1.88E+12
15			217.9	1.08E+12
14			219.9	5.54E+11
13			222.0	5.04E+11
12			222.2	5.20E+11
11			222.0	6.22E+11
10			225.3	5.43E+11
9			230.0	3.53E+11
8			236.8	4.25E+11
7			245.4	5.16E+11
6			250.9	5.94E+11
5			257.5	6.45E+11
4				7.78E+11
3				7.63E+11
2				7.82E+11
1				8.35E+11
0				

MT-135-65 Jan 13, 1997 1100JST
Ozonesonde Jan 13, 1997 1330JST

Altitude	O_3 Density	Estimated Error	Temperature	Ozonesonde
49	2.19E+10	26.2	261.7	
48	8.10E+10	22.8	263.3	
47	1.23E+11	11.9	260.0	
46	1.65E+11	6.1	258.4	
45	2.06E+11	2.8	256.6	
44	2.53E+11	2.1	257.8	
43	3.28E+11	1.8	257.0	
42	4.08E+11	1.5	255.9	
41	5.04E+11	3.8	256.8	
40	5.97E+11	1.1	254.7	
39	7.01E+11	1.7	252.3	
38	8.41E+11	1.8	253.5	
37	9.97E+11	1.8	251.1	
36	1.15E+12	0.3	247.4	
35	1.35E+12	0.7	244.6	
34	1.58E+12	0.7	244.5	
33	1.83E+12	0.7	240.3	
32	2.09E+12	3.1	233.9	
31	2.32E+12	4.0	233.4	9.01E+11
30	2.50E+12	3.6	227.0	1.10E+12
29	2.69E+12	1.3	225.9	1.46E+12
28	2.92E+12	1.3	226.8	1.71E+12
27	3.26E+12	1.5	224.1	2.07E+12
26	3.63E+12	0.5	223.1	2.58E+12
25	3.75E+12	1.2	221.4	3.26E+12
24	3.67E+12	3.6	217.0	3.41E+12
23	3.45E+12	2.1	220.4	3.22E+12
22	3.43E+12	3.0	219.5	3.31E+12
21	3.41E+12	2.9	217.0	3.52E+12
20	2.86E+12	5.0	216.9	2.64E+12
19	2.22E+12	4.8	216.8	2.52E+12
18	1.72E+12	6.6	215.4	2.81E+12
17	1.44E+12	15.2	217.3	2.63E+12
16	1.22E+12	21.9	218.0	1.88E+12
15			217.9	1.08E+12
14			219.9	5.54E+11
13			222.0	5.04E+11
12			222.2	5.20E+11
11			222.0	6.22E+11
10			225.3	5.43E+11
9			230.0	3.53E+11
8			236.8	4.25E+11
7			245.4	5.16E+11
6			250.9	5.94E+11
5			257.5	6.45E+11
4				7.78E+11
3				7.63E+11
2				7.82E+11
1				8.35E+11
0				

MT-135-66 Sep 8, 1997 1100JST
Ozonesonde Sep 8, 1997 1330JST

Altitude	O_3 Density	Estimated Error	Temperature	Ozonesonde
48	1.50E+11	3.1	262.6	
47	1.89E+11	3.2	262.9	
46	2.30E+11	3.4	265.1	
45	2.78E+11	3.5	264.9	
44	3.29E+11	2.9	257.7	
43	3.88E+11	3.1	264.1	
42	4.55E+11	3.4	256.2	
41	5.40E+11	3.7	254.4	
40	6.59E+11	4.1	250.0	
39	8.14E+11	1.4	246.1	
38	1.00E+12	1.2	244.6	
37	1.20E+12	1.3	243.9	
36	1.41E+12	1.5	239.4	
35	1.63E+12	1.8	235.1	
34	1.90E+12	1.7	231.2	
33	2.20E+12	1.7	232.2	
32	2.55E+12	1.7	232.7	
31	2.96E+12	2.1	231.9	
30	3.41E+12	3.0	230.0	
29	3.81E+12	3.1	226.8	
28	4.11E+12	4.2	225.3	
27	4.29E+12	5.2	220.3	
26	4.36E+12	6.8	216.7	
25	4.31E+12	8.5	216.2	
24	4.07E+12	8.1	217.3	
23	3.70E+12	9.4	212.4	
22	3.27E+12	14.1	208.4	
21	2.74E+12	22.5	207.5	2.41E+12
20	2.10E+12	17.6	205.1	2.15E+12
19	1.36E+12	18.4	200.7	1.49E+12
18	5.57E+11	24.0	198.7	1.04E+12
17			194.9	3.96E+11
16			195.9	3.58E+11
15			199.9	2.62E+11
14			208.8	2.63E+11
13			214.0	2.31E+11
12			220.8	3.77E+11
11			230.0	4.65E+11
10			238.7	5.24E+11
9			246.7	6.77E+11
8			254.7	5.47E+11
7			262.5	5.43E+11
6			268.8	5.74E+11
5			275.2	6.18E+11
4			284.1	8.74E+11
3			291.8	8.88E+11
2			297.4	8.68E+11
1			299.6	
0				

MT-135-67 Sep 9, 1997 1100JST
Ozonesonde Sep 9, 1997 1330JST

Altitude	O_3 Density	Estimated Error	Temperature	Ozonesonde
52	8.24E+10	6.9	299.1	
51	1.12E+11	7.0	266.6	
50	1.41E+11	4.6	271.0	
49	1.67E+11	3.7	270.2	
48	1.88E+11	3.8	262.9	
47	2.13E+11	2.3	264.0	
46	2.30E+11	3.5	262.6	
45	2.52E+11	3.7	259.8	
44	2.92E+11	3.7	257.0	
43	3.53E+11	2.9	262.7	
42	4.43E+11	3.6	259.3	
41	5.49E+11	2.5	252.5	
40	6.60E+11	2.7	246.7	
39	8.14E+11	3.1	245.3	
38	1.00E+12	3.4	239.1	
37	1.21E+12	2.1	238.8	
36	1.42E+12	2.4	238.2	
35	1.64E+12	2.7	240.1	1.22E+12
34	1.89E+12	2.7	230.3	1.79E+12
33	2.19E+12	2.3	233.0	2.10E+12
32	2.51E+12	3.9	232.5	2.35E+12
31	2.85E+12	5.2	234.2	2.68E+12
30	3.20E+12	6.9	230.1	2.99E+12
29	3.50E+12	4.5	229.2	3.19E+12
28	3.79E+12	5.8	227.0	3.41E+12
27	3.96E+12	6.1	224.2	3.59E+12
26	4.00E+12	16.4	222.3	3.68E+12
25	3.89E+12	9.7	220.1	3.62E+12
24	3.54E+12	15.9	215.3	3.32E+12
23	3.21E+12	12.5	213.7	2.88E+12
22	2.78E+12	13.0	214.7	2.69E+12
21	2.31E+12	18.5	210.5	2.38E+12
20	1.80E+12	14.7	209.6	1.69E+12
19	1.25E+12	24.7	205.3	1.26E+12
18	6.99E+11	27.4	202.4	8.76E+11
17	1.49E+11	27.4	201.6	4.67E+11
16			201.1	3.59E+11
15			205.8	1.99E+11
14			213.0	2.63E+11
13			219.4	3.42E+11
12			225.3	5.30E+11
11			231.1	5.61E+11
10			238.4	5.67E+11
9			245.9	5.89E+11
8			253.9	5.69E+11
7			261.1	5.99E+11
6			266.0	6.21E+11
5			273.8	6.65E+11
4			279.9	7.92E+11
3			286.5	9.58E+11
2			287.5	9.50E+11
1				
0				

MT-135-68 Sep 7, 1998 1100JST
Ozonesonde Sep 6, 1998 1330JST

Altitude	O_3 Density	Estimated Error	Temperature	Ozonesonde
56	1.51E+10	7.0	268.5	
55	2.25E+10	5.3	259.4	
54	2.99E+10	5.6	262.6	
53	3.79E+10	4.5	262.6	
52	4.82E+10	3.6	262.2	
51	5.76E+10	2.8	263.0	
50	6.64E+10	1.5	263.9	
49	7.96E+10	2.5	267.7	
48	9.99E+10	1.5	267.9	
47	1.22E+11	1.7	266.4	
46	1.51E+11	1.6	267.8	
45	1.88E+11	3.0	273.2	
44	2.45E+11	2.6	269.5	
43	3.33E+11	1.7	259.1	
42	4.39E+11	2.1	253.9	
41	5.55E+11	2.7	256.6	
40	6.77E+11	3.2	250.4	
39	8.28E+11	2.5	243.4	
38	9.97E+11	3.8	244.1	
37	1.22E+12	2.4	242.2	
36	1.48E+12	3.6	240.0	
35	1.76E+12	2.3	237.4	
34	2.04E+12	1.8	234.1	
33	2.33E+12	2.2	233.3	
32	2.71E+12	3.0	229.3	
31	3.16E+12	4.7	231.7	
30	3.54E+12	4.3	232.2	
29	3.87E+12	3.4	232.4	
28	4.18E+12	4.0	225.8	5.75E+12
27	4.41E+12	4.8	224.3	6.23E+12
26	4.55E+12	5.0	223.2	6.54E+12
25	4.66E+12	4.8	220.0	6.19E+12
24	4.66E+12	4.4	219.9	5.24E+12
23	4.28E+12	5.0	217.8	4.54E+12
22	3.74E+12	3.0	213.6	3.87E+12
21	3.22E+12	9.5	213.9	3.33E+12
20	2.68E+12	7.8	212.5	1.89E+12
19	2.02E+12	8.9	208.6	1.53E+12
18	1.38E+12	33.3	207.8	1.53E+12
17			204.3	1.53E+12
16			203.0	1.53E+12
15			204.3	1.53E+12
14			210.4	1.53E+12
13			218.4	4.54E+11
12			226.3	4.54E+11
11			234.5	4.54E+11
10			242.7	4.54E+11
9			249.2	4.54E+11
8			256.9	4.54E+11
7			263.2	4.65E+11
6			268.4	5.27E+11
5			274.6	6.98E+11
4			280.6	7.32E+11
3			282.2	7.80E+11
2			248.2	8.44E+11
1			238.4	1.32E+12
0				

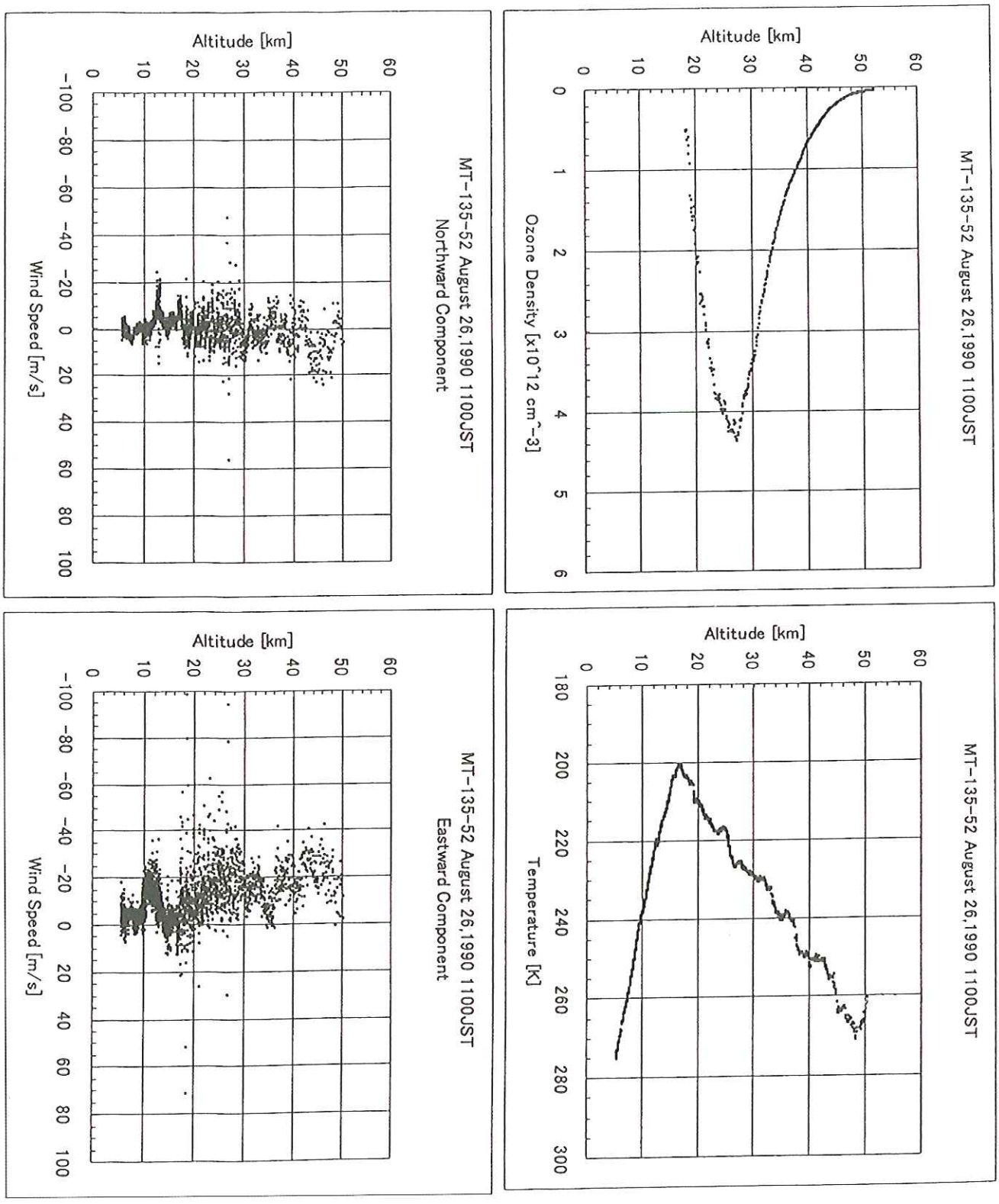
MT-135-69 Sep 8, 1998 1100JST
Ozonesonde Sep 8, 1998 1330JST

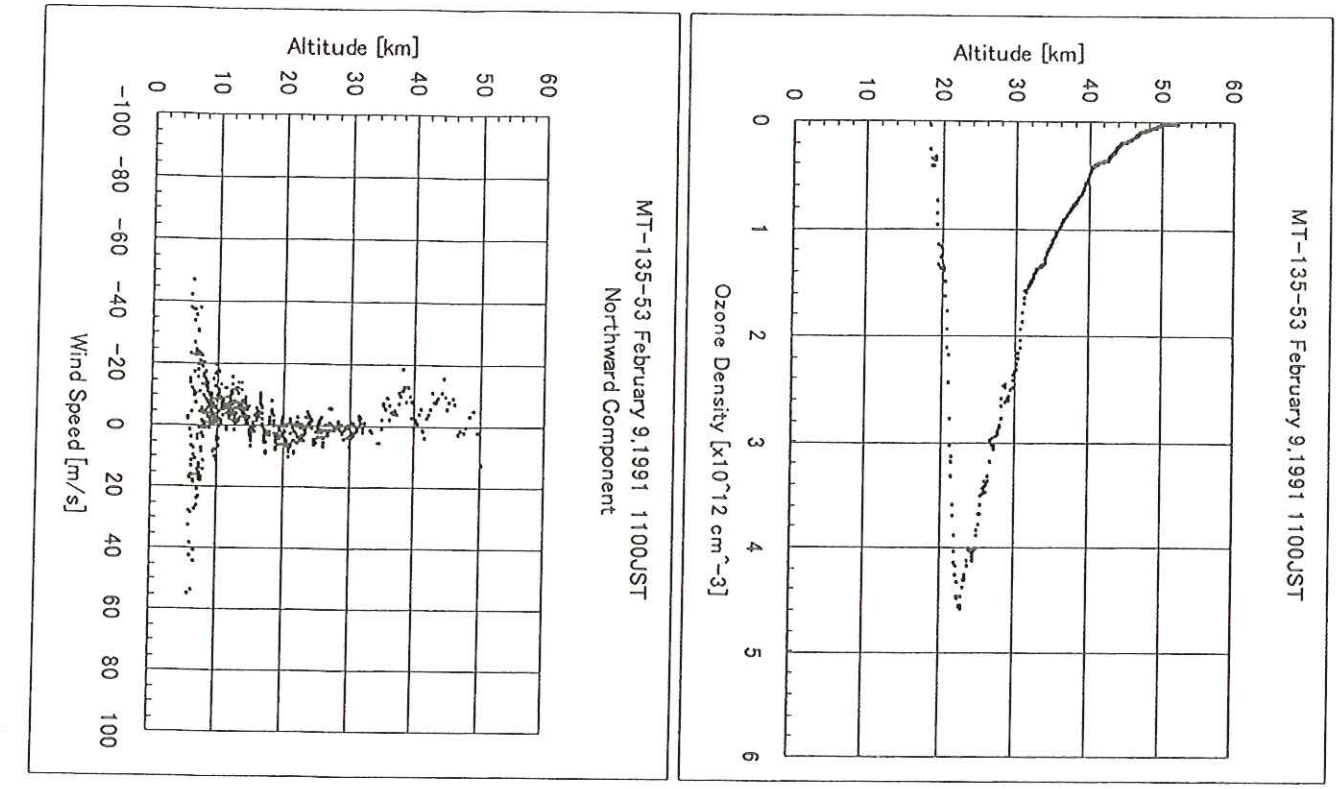
Altitude	O_3 Density	Estimated Error	Temperature	Ozonesonde
53	2.06E+10	12.3		
52	3.38E+10	7.6		
51	4.70E+10	5.5		
50	6.15E+10	4.5		
49	8.07E+10	4.7	264.8	
48	1.05E+11	4.4	265.7	
47	1.32E+11	3.7	264.0	
46	1.60E+11	2.9	262.8	
45	1.96E+11	1.4	263.7	
44	2.45E+11	1.5	266.1	
43	3.20E+11	2.5	263.1	
42	4.27E+11	4.4	259.6	
41	5.58E+11	5.5	250.8	
40	6.92E+11	4.0	248.3	
39	8.49E+11	3.0	247.2	
38	1.04E+12	1.3	246.9	
37	1.29E+12	0.6	250.1	
36	1.55E+12	0.0	247.2	
35	1.78E+12	0.4	237.9	
34	2.11E+12	0.7	235.1	
33	2.52E+12	1.8	232.9	
32	2.96E+12	2.1	234.0	
31	3.35E+12	2.4	234.3	
30	3.61E+12	2.8	232.1	
29	3.87E+12	3.3	229.9	
28	4.22E+12	3.6	230.5	
27	4.66E+12	3.8	230.4	5.47E+12
26	5.02E+12	3.4	229.6	5.92E+12
25	5.18E+12	1.7	226.6	5.40E+12
24	5.03E+12	2.1	221.9	5.40E+12
23	4.63E+12	2.5	220.5	4.89E+12
22	4.05E+12	2.9	218.6	3.97E+12
21	3.36E+12	3.2	215.8	3.04E+12
20	2.58E+12	3.4	215.2	2.44E+12
19	1.80E+12	4.4	212.9	1.99E+12
18	1.11E+12	9.2	210.8	1.32E+12
17	4.04E+11	6.4	206.1	6.35E+11
16	2.02E+12	13.5	206.1	4.79E+11
15	1.38E+12	19.1	207.9	4.36E+11
14			212.9	3.70E+11
13			219.5	3.75E+11
12			227.7	4.39E+11
11			234.7	4.39E+11
10			243.1	4.70E+11
9			250.0	4.23E+11
8			257.6	6.20E+11
7			262.4	1.04E+12
6			266.0	1.14E+12
5			272.7	1.12E+12
4			279.5	1.34E+12
3			279.2	1.32E+12
2			247.3	1.30E+12
1			239.7	1.46E+12
0				

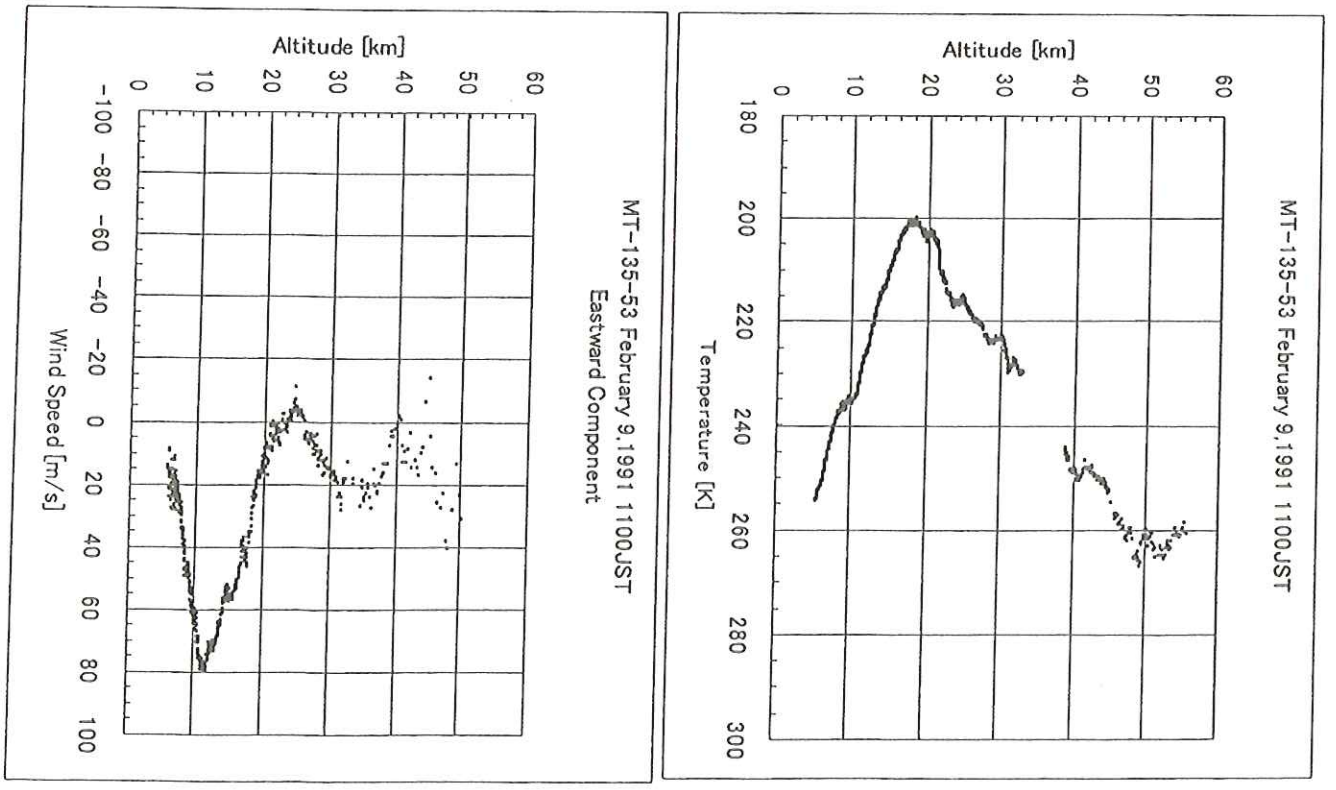
MT-135-70 Sep7,1999 1100JST
Ozonesonde Sep7 , 1999 1330JST

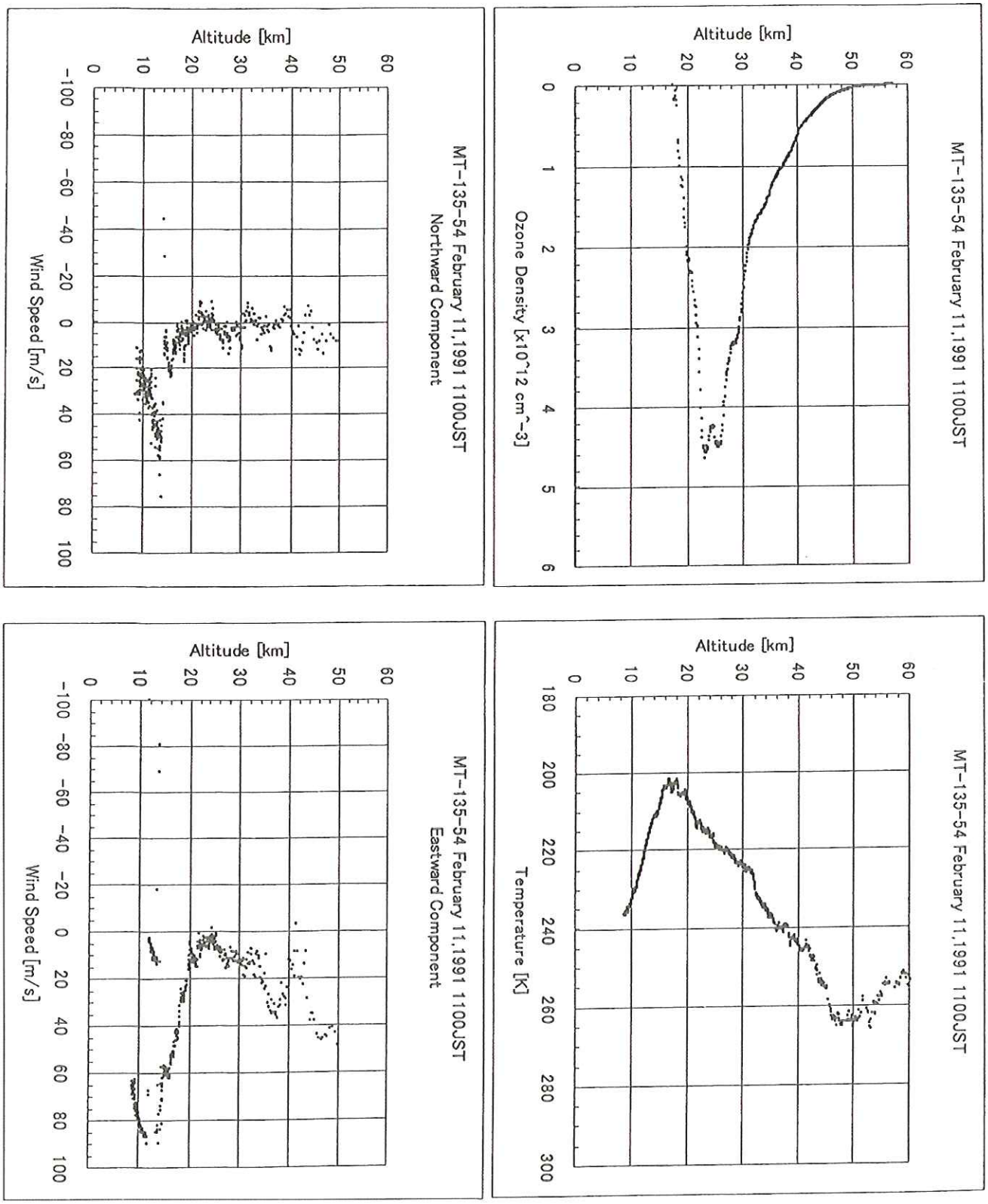
Altitude	O_3 Density	Estimated Error	Temperature	Ozonesonde
54	2.22E+10	4.5		
53	2.92E+10	1.8		
52	3.61E+10	1.4		
51	4.67E+10	0.8		
50	5.90E+10	1.3		
49	7.74E+10	0.7		
48	9.68E+10	1.7		
47	1.20E+11	1.6		
46	1.54E+11	3.0		
45	1.93E+11	2.7		
44	2.42E+11	1.7		
43	3.03E+11	2.1		
42	3.76E+11	2.7		
41	4.87E+11	3.3		
40	6.16E+11	2.5		
39	7.78E+11	3.8		2.32E+11
38	9.64E+11	2.4		3.00E+11
37	1.17E+12	3.7		4.33E+11
36	1.39E+12	2.3		6.83E+11
35	1.58E+12	1.9		1.24E+12
34	1.76E+12	2.2		1.54E+12
33	2.04E+12	3.0		1.89E+12
32	2.35E+12	4.7		2.42E+12
31	2.75E+12	4.3		3.01E+12
30	3.20E+12	3.5		3.88E+12
29	3.64E+12	4.1		4.64E+12
28	4.00E+12	4.9		5.12E+12
27	4.14E+12	5.1		5.36E+12
26	4.10E+12	4.8		5.69E+12
25	3.93E+12	4.5		5.49E+12
24	3.71E+12	5.1		5.45E+12
23	3.33E+12	3.1		4.74E+12
22	2.89E+12	9.6		3.69E+12
21	2.29E+12	7.9		3.02E+12
20	1.60E+12	9.0		2.23E+12
19	9.00E+11	33.7		1.42E+12
18	2.15E+11	181.6		9.69E+11
17				5.19E+11
16				3.84E+11
15				2.38E+11
14				2.38E+11
13				2.40E+11
12				2.84E+11
11				3.05E+11
10				3.64E+11
9				4.62E+11
8				4.88E+11
7				4.66E+11
6				3.85E+11
5				4.39E+11
4				4.87E+11
3				4.04E+11
2				2.72E+11
1				2.03E+11
0				

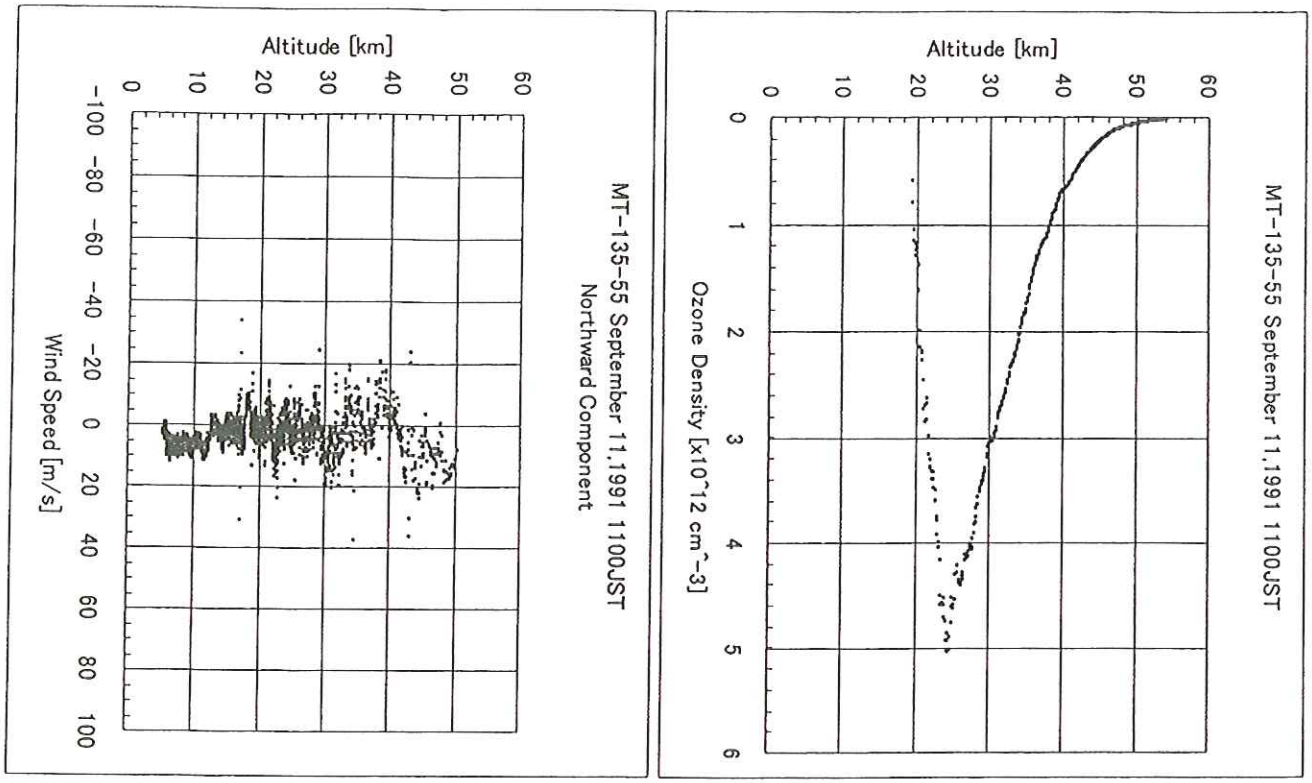
Figure5 -1～17. Ozone, temperature and wind profiles obtained with MT-135 rockets.

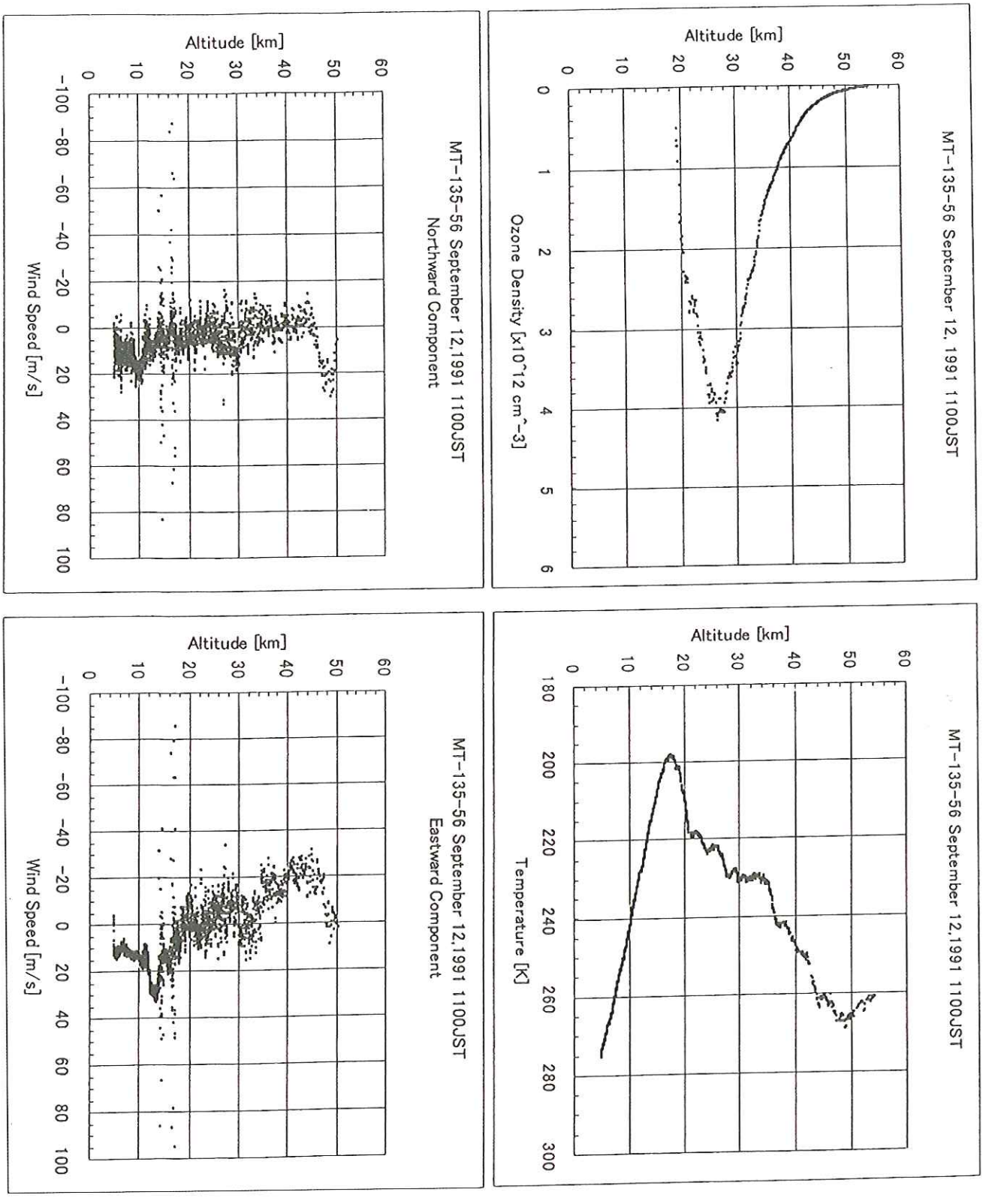


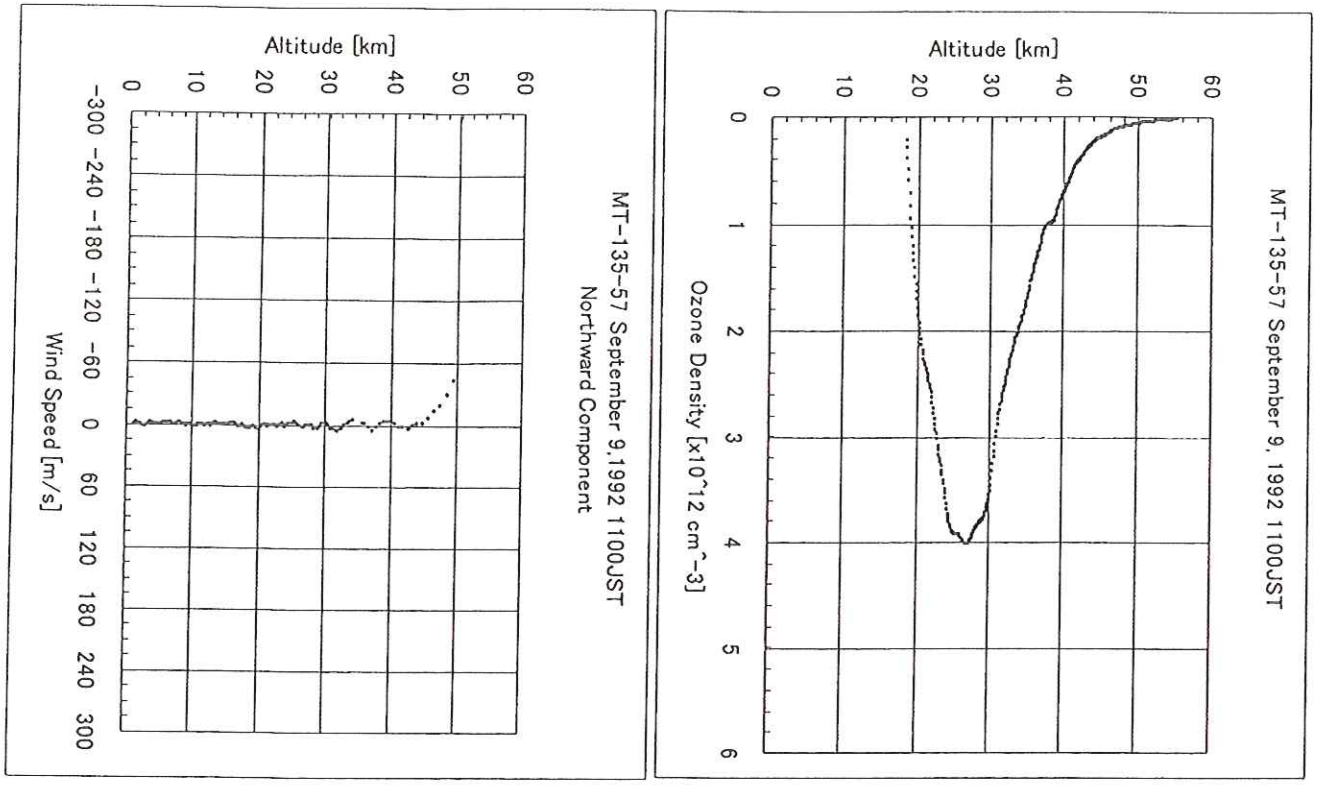


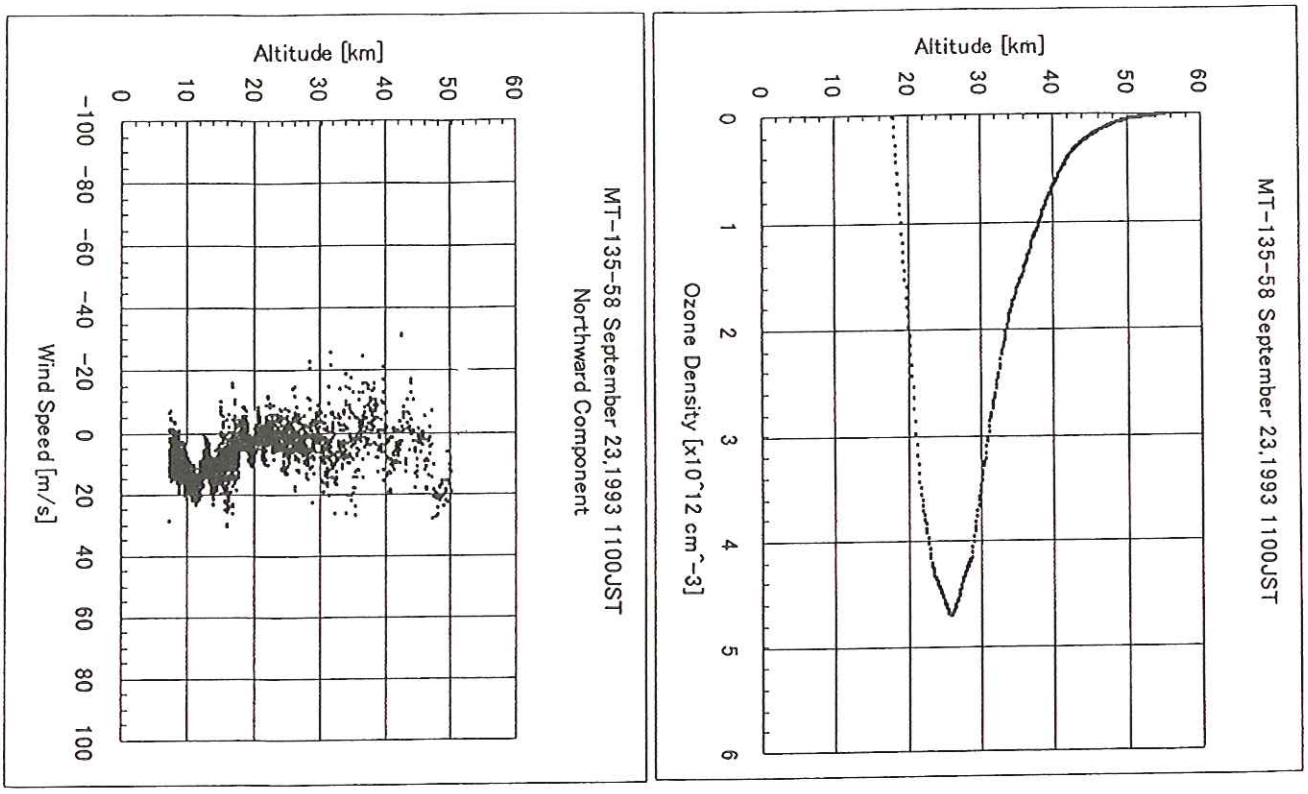


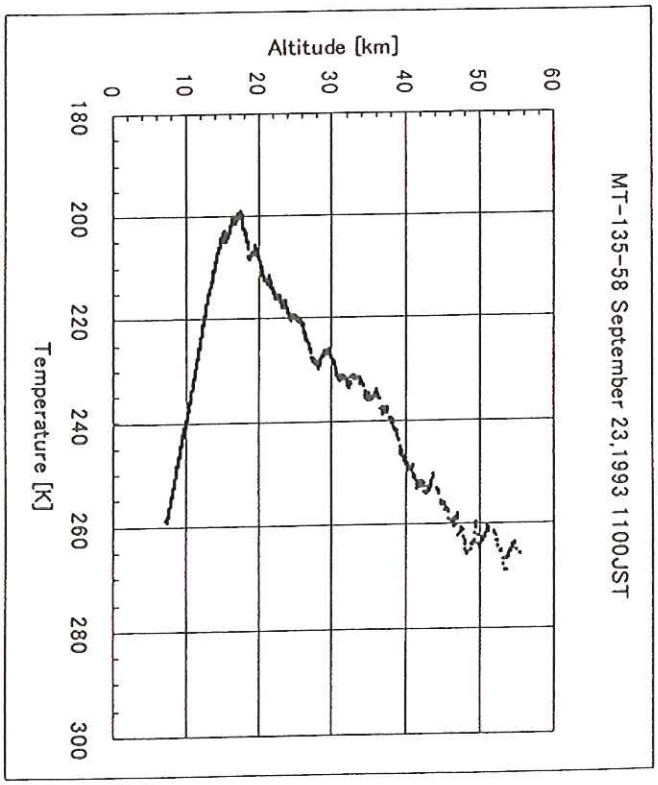


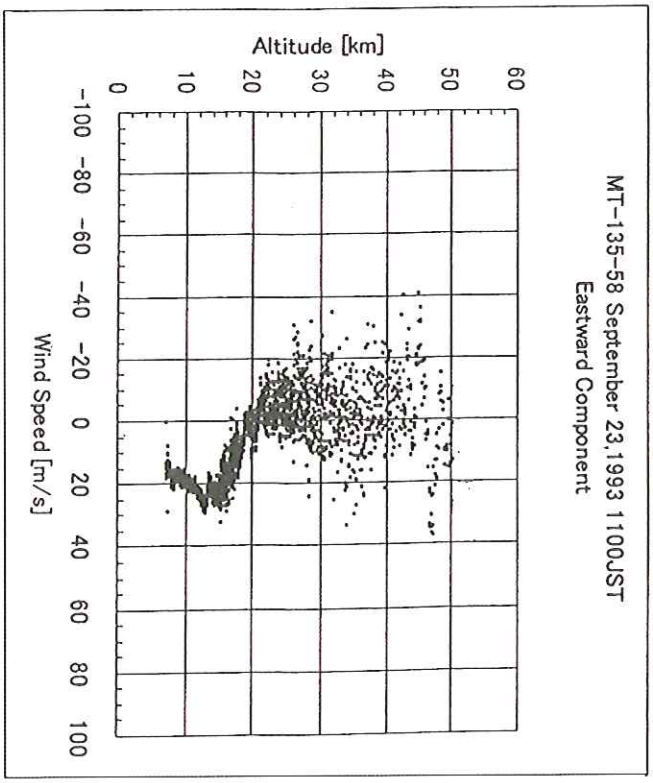


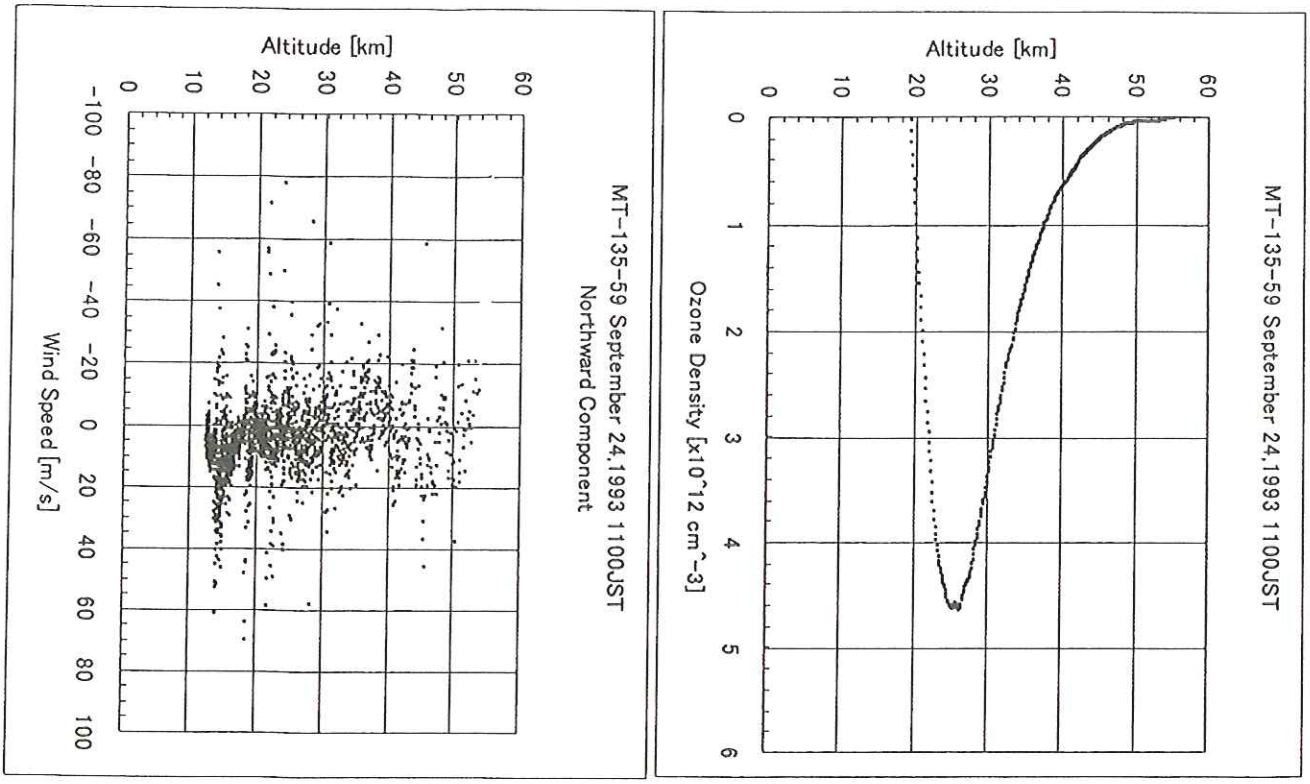


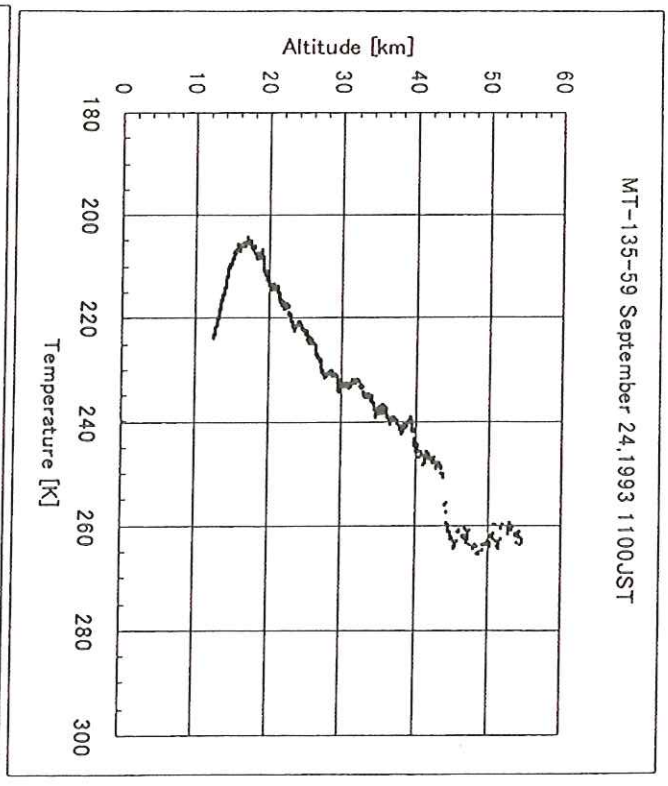


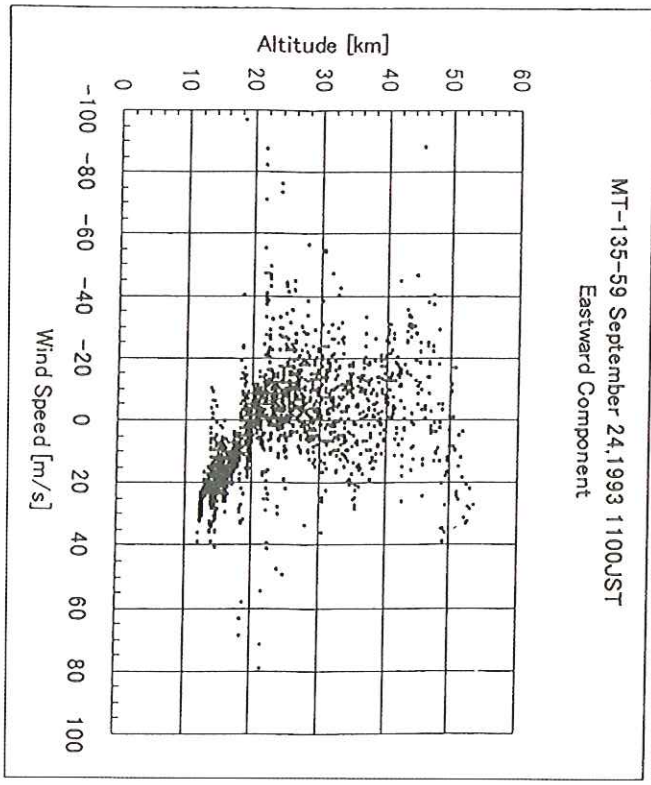


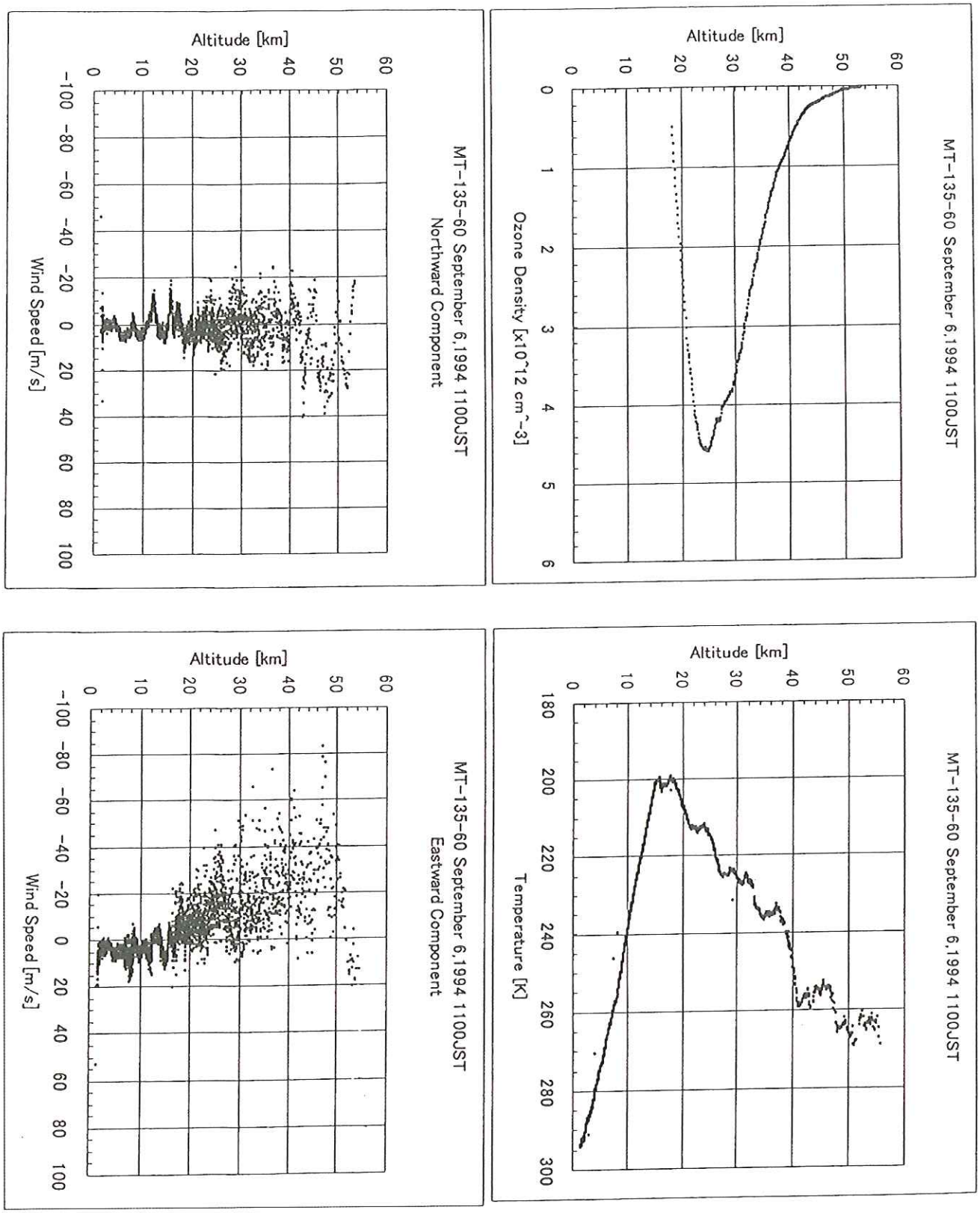


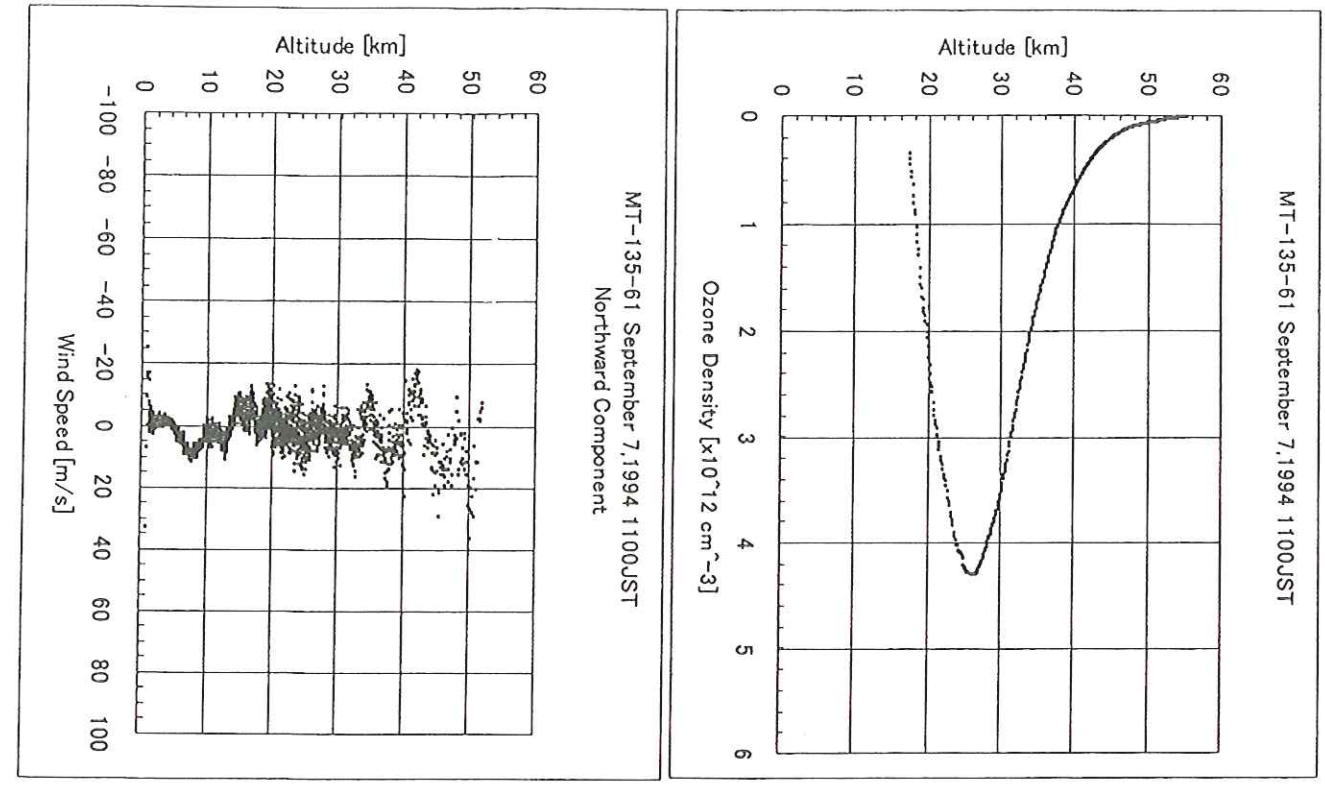


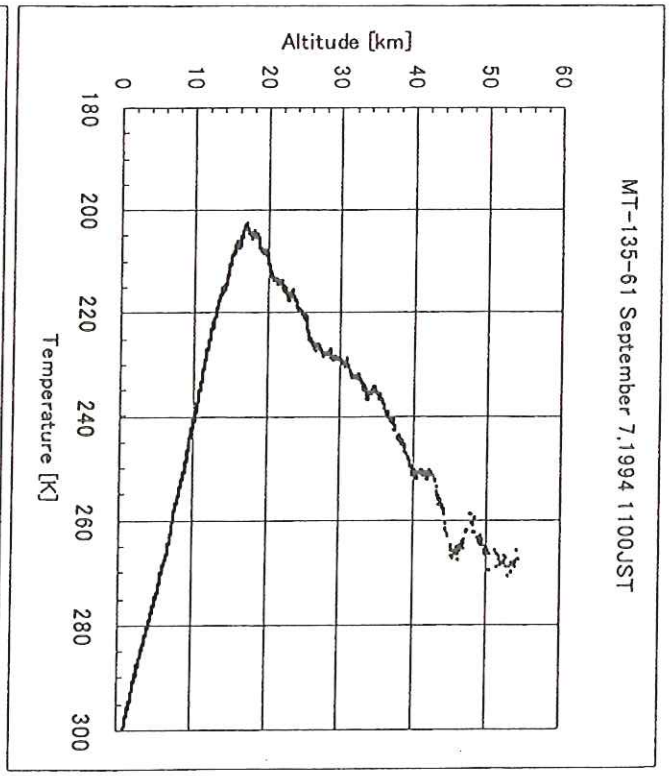


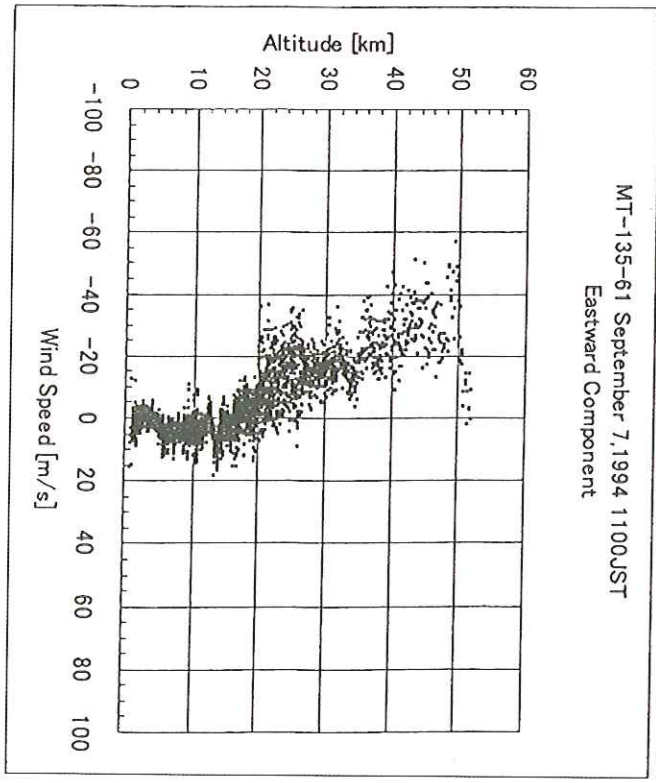


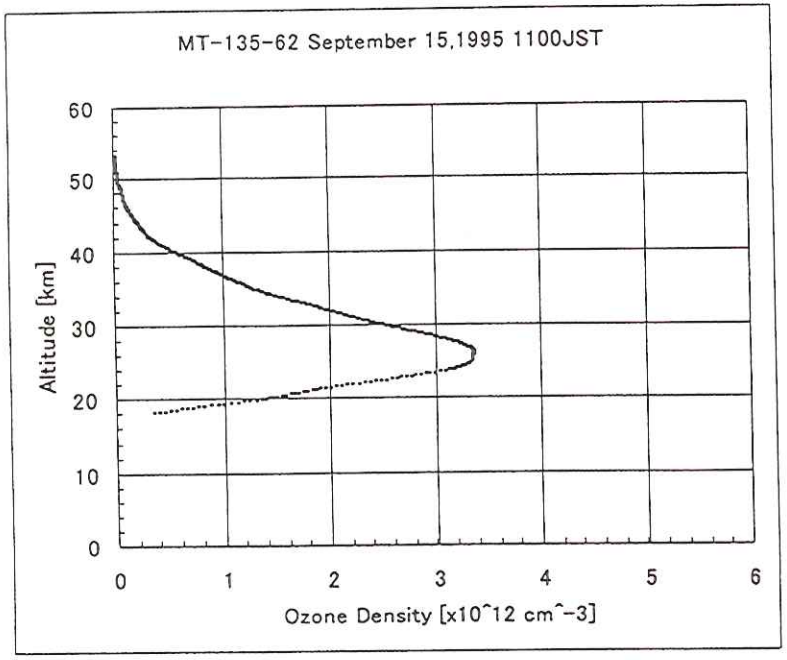


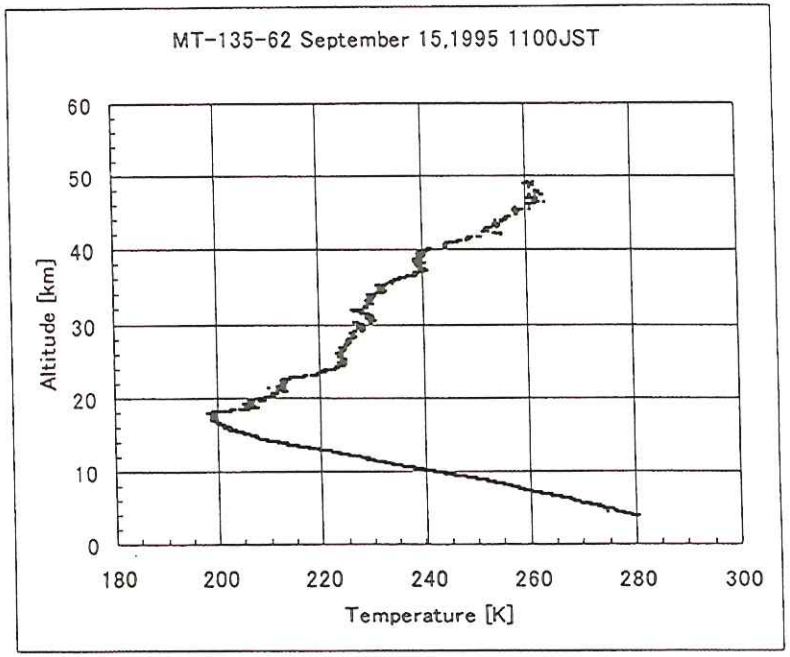












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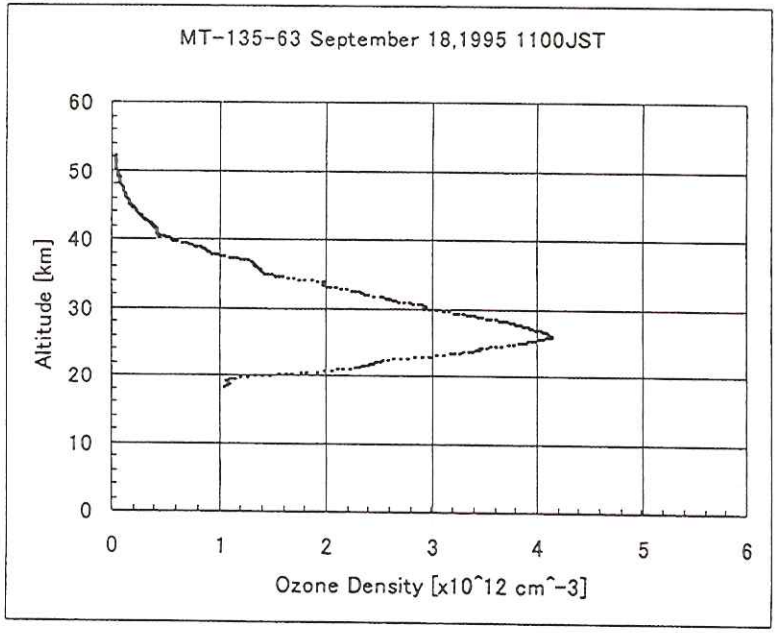

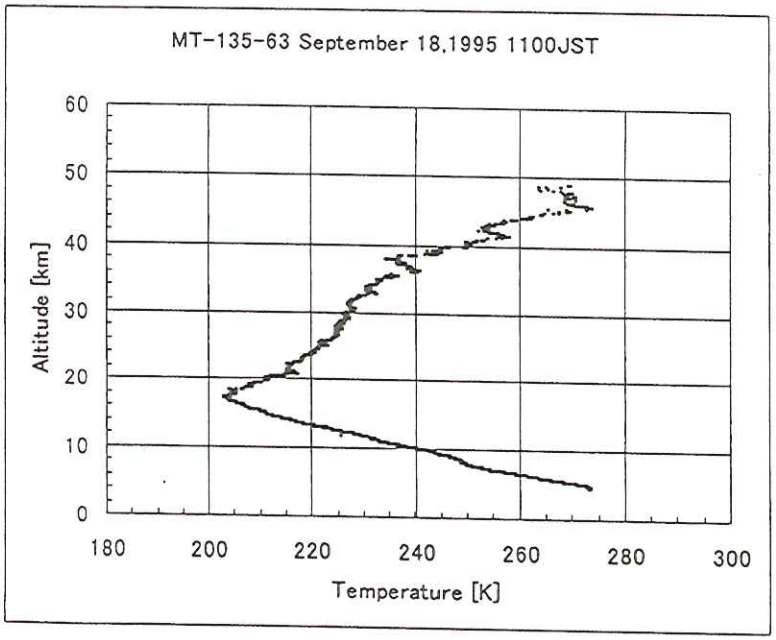

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