Spectral Transmittance Simulation for the ILAS Infrared (830-1,650cm^{-1}) and Visible (12,740-13,280cm^{-1}) Regions

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Preface

Environment Agency has been developing a satellite-borne instrument for observing distribution of atmospheric constituents related to the stratospheric ozone layer chemistry. The instrument is called Imporoved Limb Atmospheric Spectrometer (ILAS), which is based on the principle of solar occultation technique in the infrared and visible region. The ILAS will be installed on the Advanced Earth Observing Satellite (ADEOS) which is planned for launch in early 1995.

The ILAS measurement gases are ozone, methane, nitrous oxide, nitric acid, water vapor, nitrogen dioxide and CFC11. Vertical profiles of these constituents are derived from transmittance measurements in the infrared (850-1610 cm^{-1}) wevelength region. Forty-four elements of pyroelectric array detectors are used for the infrared measurements.

Temperature and pressure profiles will be obtained from transmittance measurements in the oxygen A-band in the visible (12755-13280 cm^{-1}) region. Aerosol information is also obtained from the visible region. A detector for the visible channel is a MOS photodiode array with 1024 elements.

The National Institute for Environmental Studies (NIES) is responsible for developing a software system for processing the ILAS data. This will include spectrum fitting and inversion software for integral equations of multiple-channel data.

This report was prepared as one of the early steps for that purpose and is intended to provide, for not only researchers involved in the ILAS data processing algorithms but also future potential users of the ILAS products, with detailed information on atmospheric absorption spectrum in the ILAS infrared and visible regions.

The report has been prepared by Dr. T. Yokota (NIES) and Dr. J. H. Park (NASA Langley Research Center) during Dr. Yokota's one-year stay (1990-1991) at NASA Langley Research Center.

We hope this report would be of great help to those who are interested in the ILAS instrument and its products.

Yasuhiro Sasano
ILAS Science Team Leader

Contents

Introduction

Presented in this report are the simulations of spectral transmittance over the 830 to 1,650 cm^{-1} range (infrared region) and over the 12,740 to 13,280 cm^{-1} range (visible region).

Temperature and pressure profiles (Fig. 1 and Table 1) are for the northern hemisphere sub-arctic (52.6°N) winter condition. The model atmosphere is adopted from ATMOS Standard Profiles for NO_2, HNO_3, CFC-11, and CFC-12, and from HALOE SIDS (Simulated Instrument Data Set) Atmosphere for the temperature, pressure, and the other gases. Gas mixing ratio profiles of nine species (H_2O, CO_2, O_3, N_2O, CH_4, NO_2, HNO_3, CFC-11($CFCl_3$), and CFC-12 (CF_2 Cl_2)) are shown in Fig. 2 and Table 1. A constant mixing ratio 0.21 is assumed for O_2.

The atmosphere is divided into 10 km thick homogeneous layers with the top of the atmosphere at 50 km (Fig. 3). Optical path refraction through the atmosphere is not considered in this simulation. The 1986 AFGL line database for the seven gases is used for the simulations. Absorption lines whose intensities (SL [cm^{-1}/(molec•cm^{-2}) @296K]) are less than SLmin are ignored in the cross section calculation; SLmin (H_2O)$=1\times10^{-24}$, SLmin (O_3)$=1\times10^{-24}$, SLmin (N_2O)$=4\times10^{-24}$, SLmin (CH_4)$=4\times10^{-24}$, SLmin (CO_2)$=1\times10^{-26}$, SLmin (NO_2)$=1\times10^{-24}$, and SLmin (HNO_3)$=4\times10^{-24}$. CFC-11 and CFC-12 are provided not by the line intensities but by the cross section data in the AFGL database. All O_2 lines in the AFGL database are included in the calculations.

Infrared Region

Shown in each page are transmittances calculated at 0.002 cm^{-1} intervals and then averaged over 0.004 cm^{-1} for every 10 cm^{-1} interval at tangent altitudes of 10, 20, 30, 40, 50 km. In the opposite page are transmittances for individual gases at a tangent altitude of 20 km. Transmittances for CFC-11 and CFC-12 are magnified 25 times in the upper charts, and they are shown only in the spectral range of 830~940 cm^{-1} and 1,060~1,180 cm^{-1}.

Visible Region

Transmittances are calculated for every 0.004 cm^{-1} interval. Shown each page are transmittances (averaged over 0.008 cm^{-1}) for every 20 cm^{-1} interval at tangent altitudes of 10, 20, 30, 40, 50 km. No aerosols are included in this simulation. Temperature dependence of O_2 band absorption is shown in Figs. 4 through 9, because this channel is used for pressure and temperature sensing of the atmosphere.

These simulations were performed on the VAX 11/785 (HALOE VAX) and VAX 11/780 (ASD (Atmosheric Sciences Division) VAX) systems in cooperation with NASA Langley Research Center. Summary of the time for calculation is shown in Appendices A, B, and C. FORTRAN programs TRN. FOR ; 50, TRNS. FOR ; 51, TRNF. FOR ; 55, TRNFS. FOR ; 54,

and TRNV. FOR ; 54 were used for the infrared and visible calculation, which were coded by T. Yokota by modifying Jae Park's program. The transmittance charts were produced by using the IDL graphic utility package.

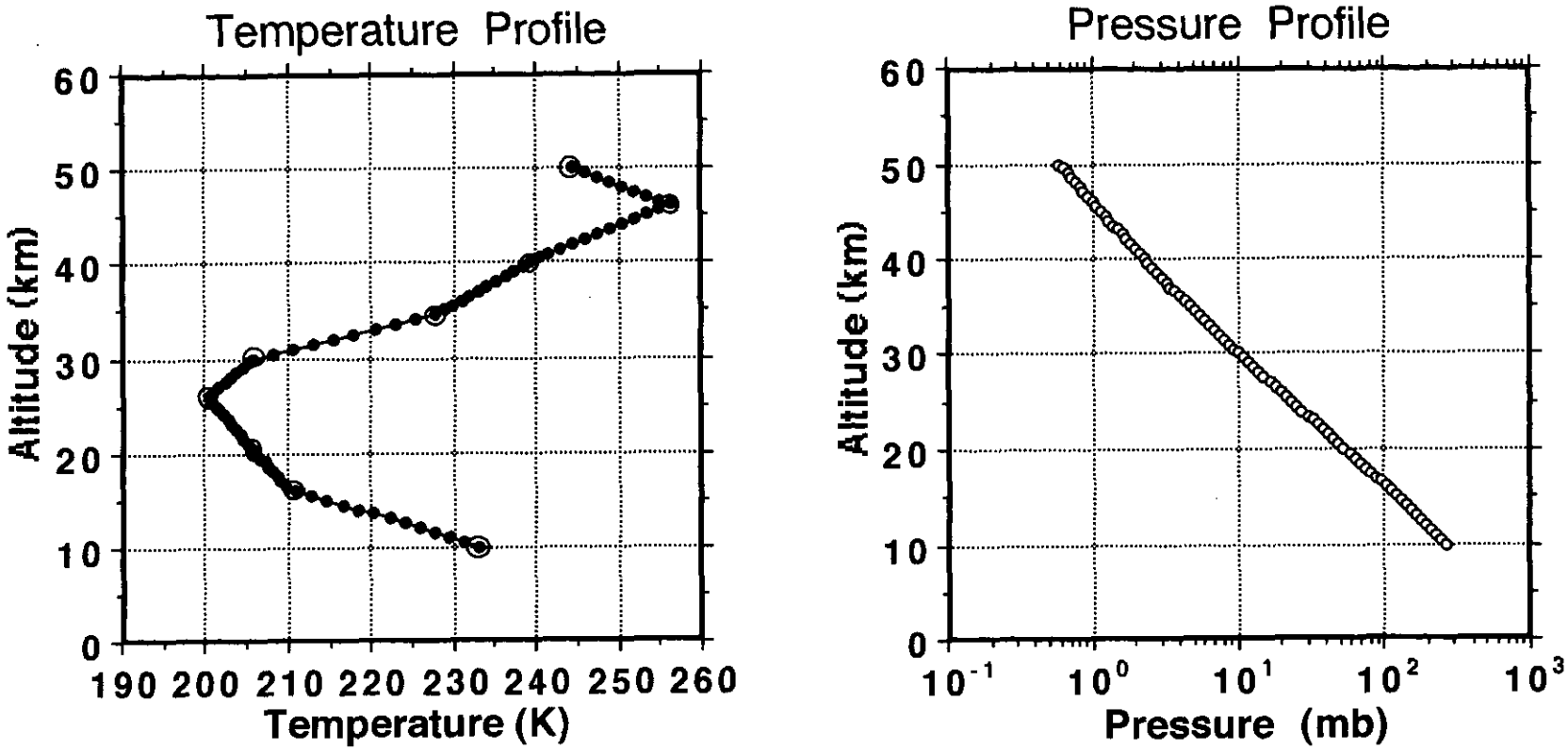


Fig.1 Temperature and Pressure Profiles (from HALOE SIDSATM_N.DAT)

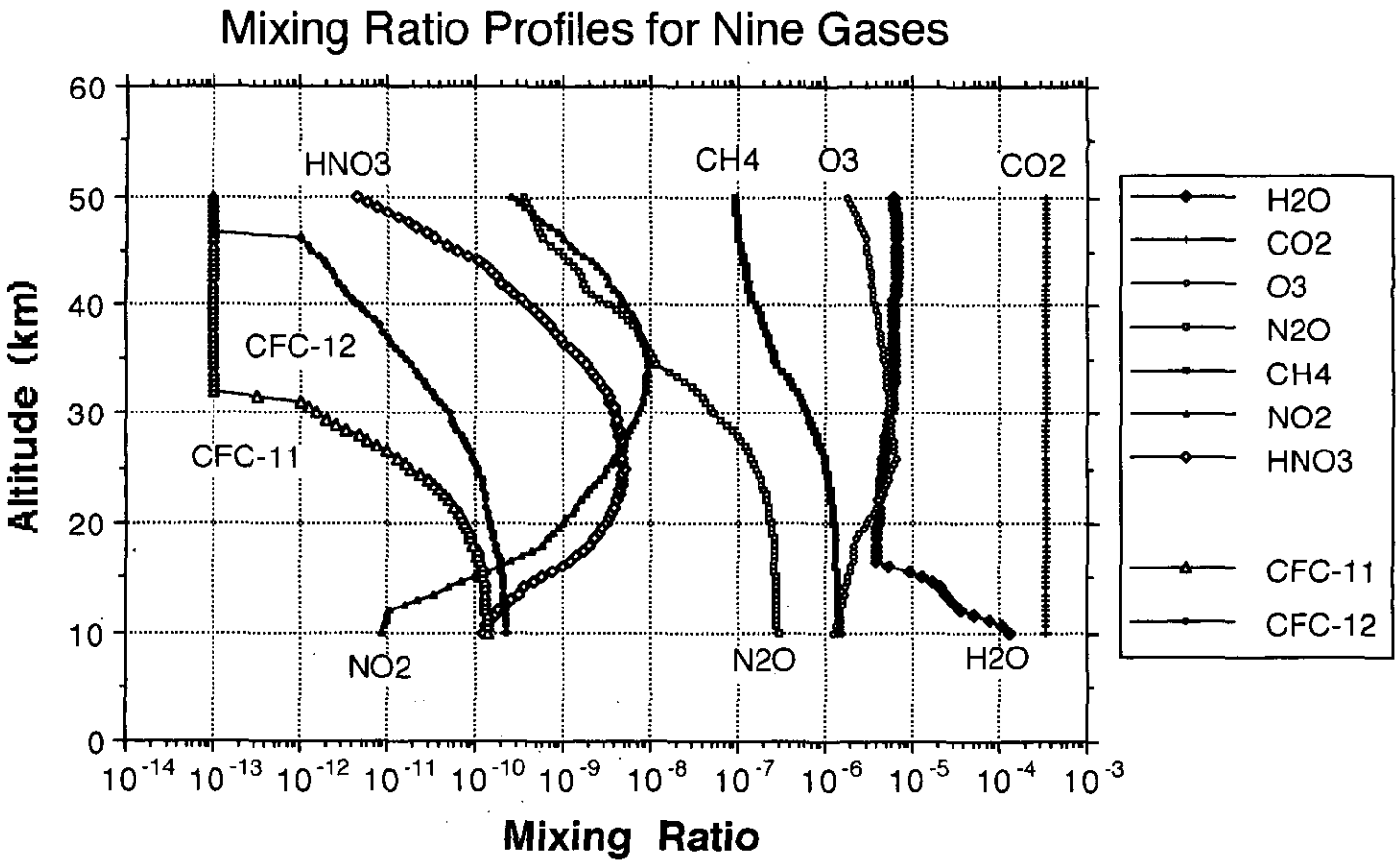
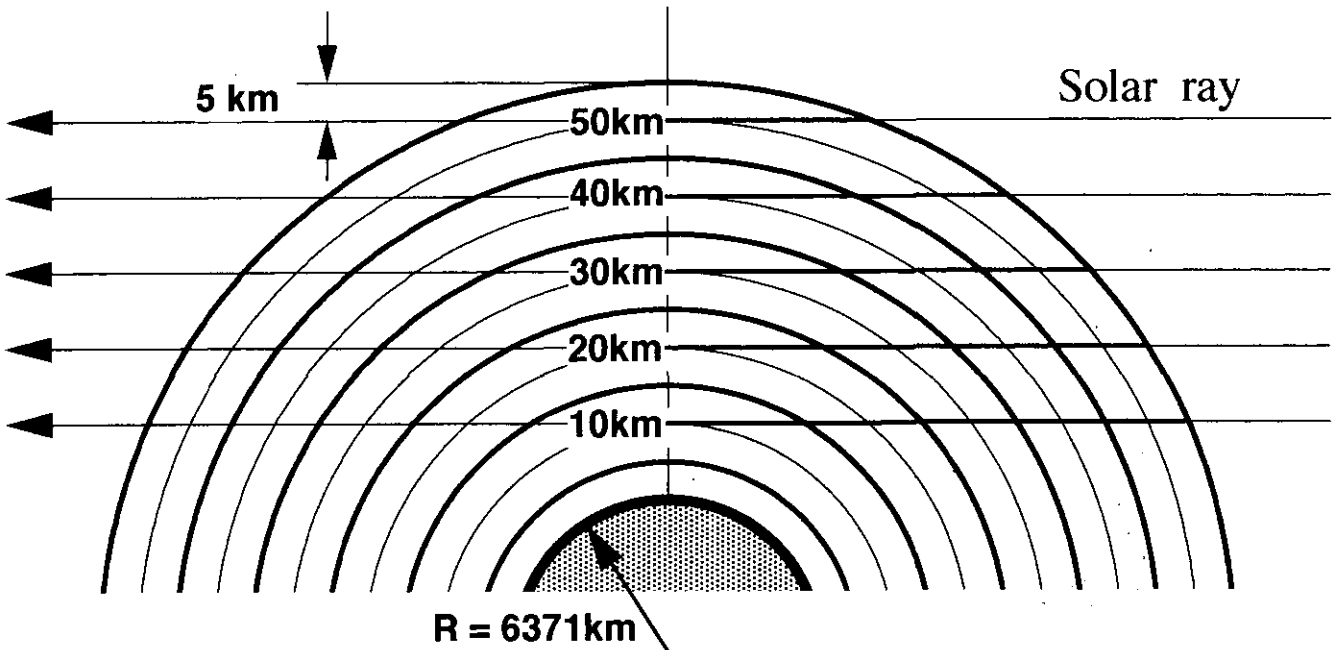


Fig.2 Mixing Ratio Profiles (from HALOE SIDSATM_N.DAT for H2O, CO2, O3, NO2, CH4), (from ATMOS Standard Profiles for NO2, HNO3, CFC-11, CFC-12)



Right half side

Path (section) length (km) =

$$\begin{pmatrix} 253.4 & & & & \\ 253.2 & 185.6 & & & \\ 253.1 & 185.4 & 127.8 & & \\ 252.9 & 185.3 & 127.7 & 103.9 & \\ 252.7 & 185.1 & 127.6 & 103.9 & 89.9 \end{pmatrix}$$

Fig.3 Limb Transmission Geometry (Homogeneous layer thickness = 10 km)

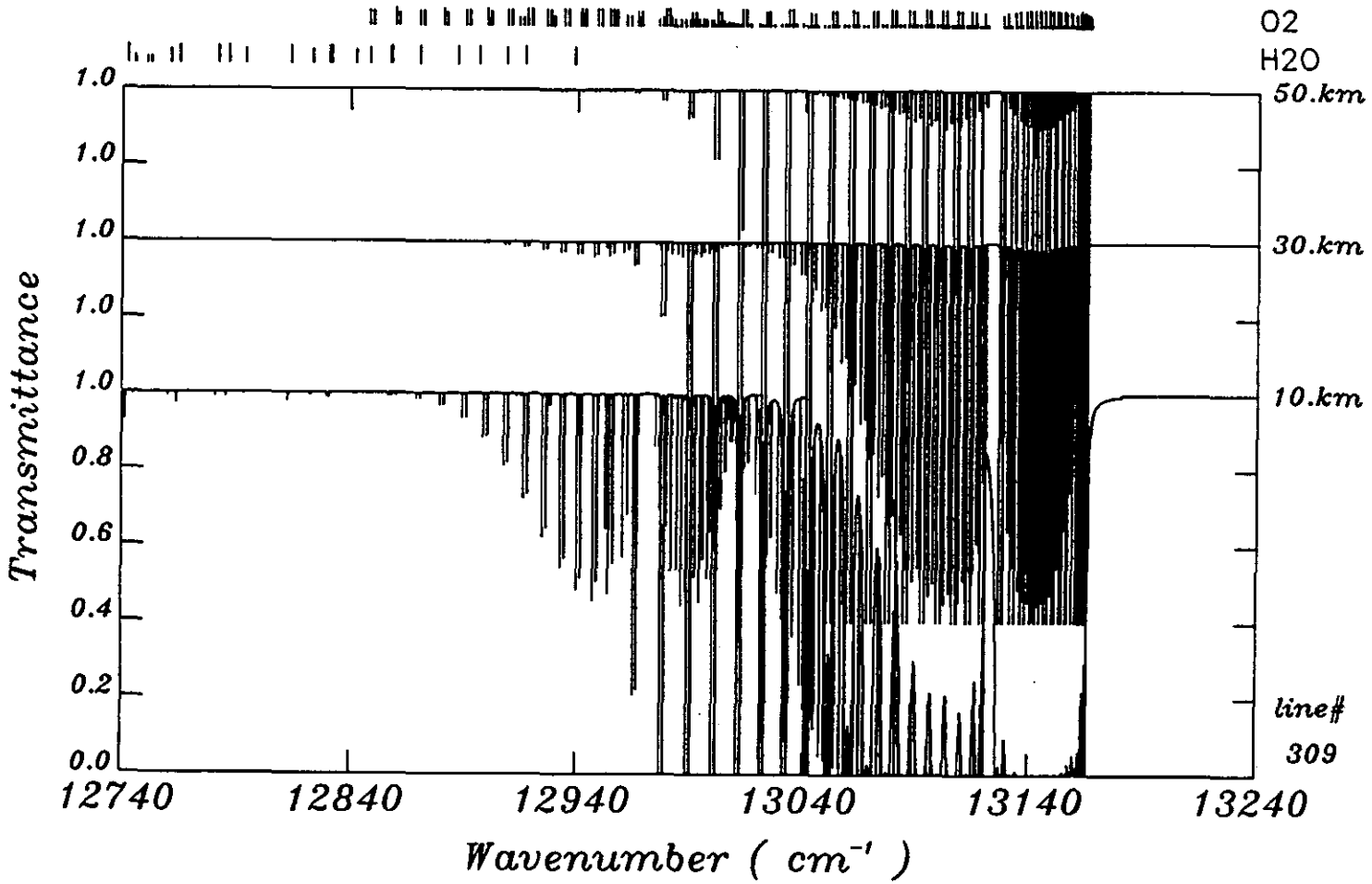


Fig.4 Transmittances in the visible spectral region at tangent altitudes of 10, 30, and 50 km (with standard temperature).

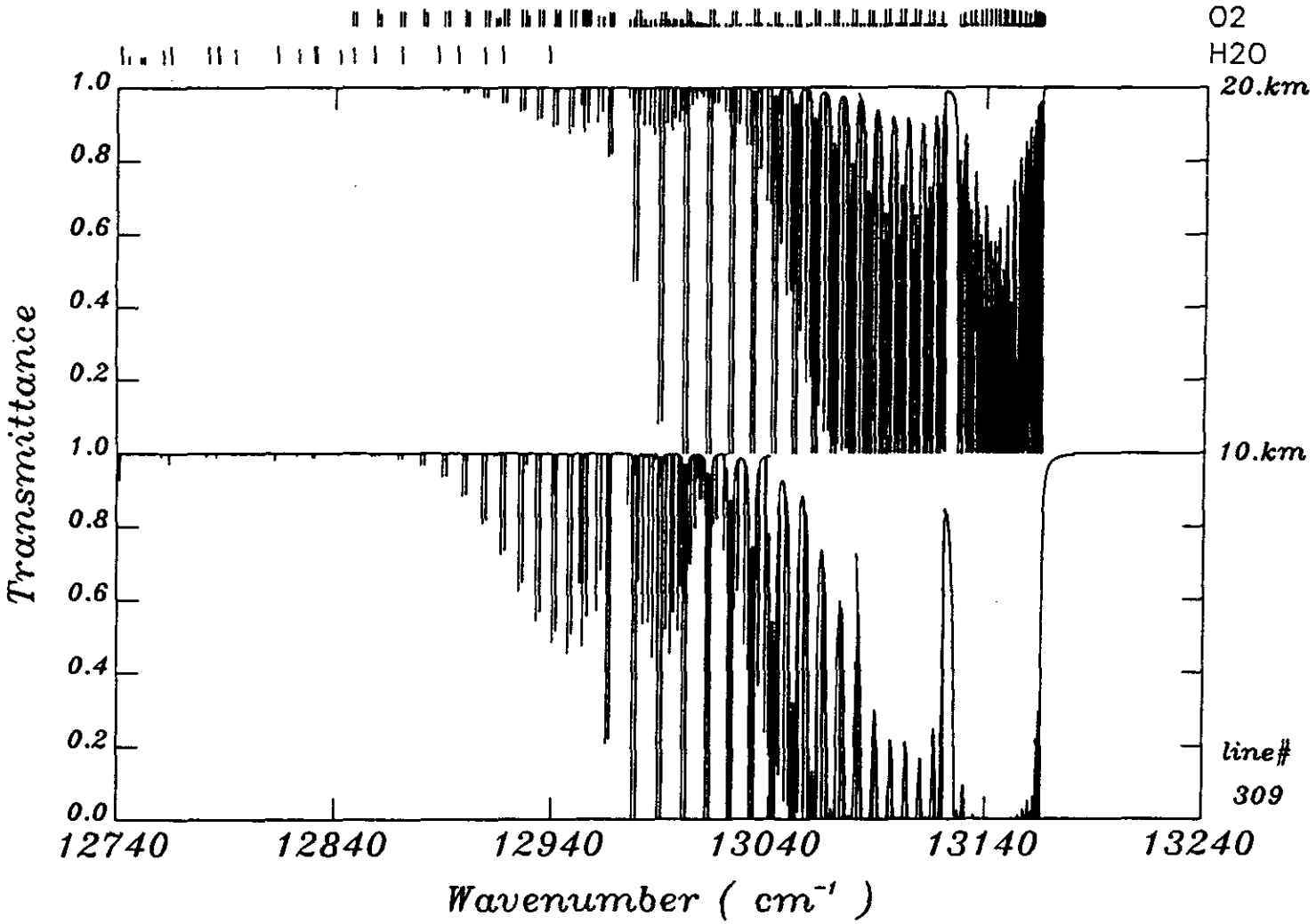


Fig.5 Transmittance comparison between 10 km and 20 km altitudes.

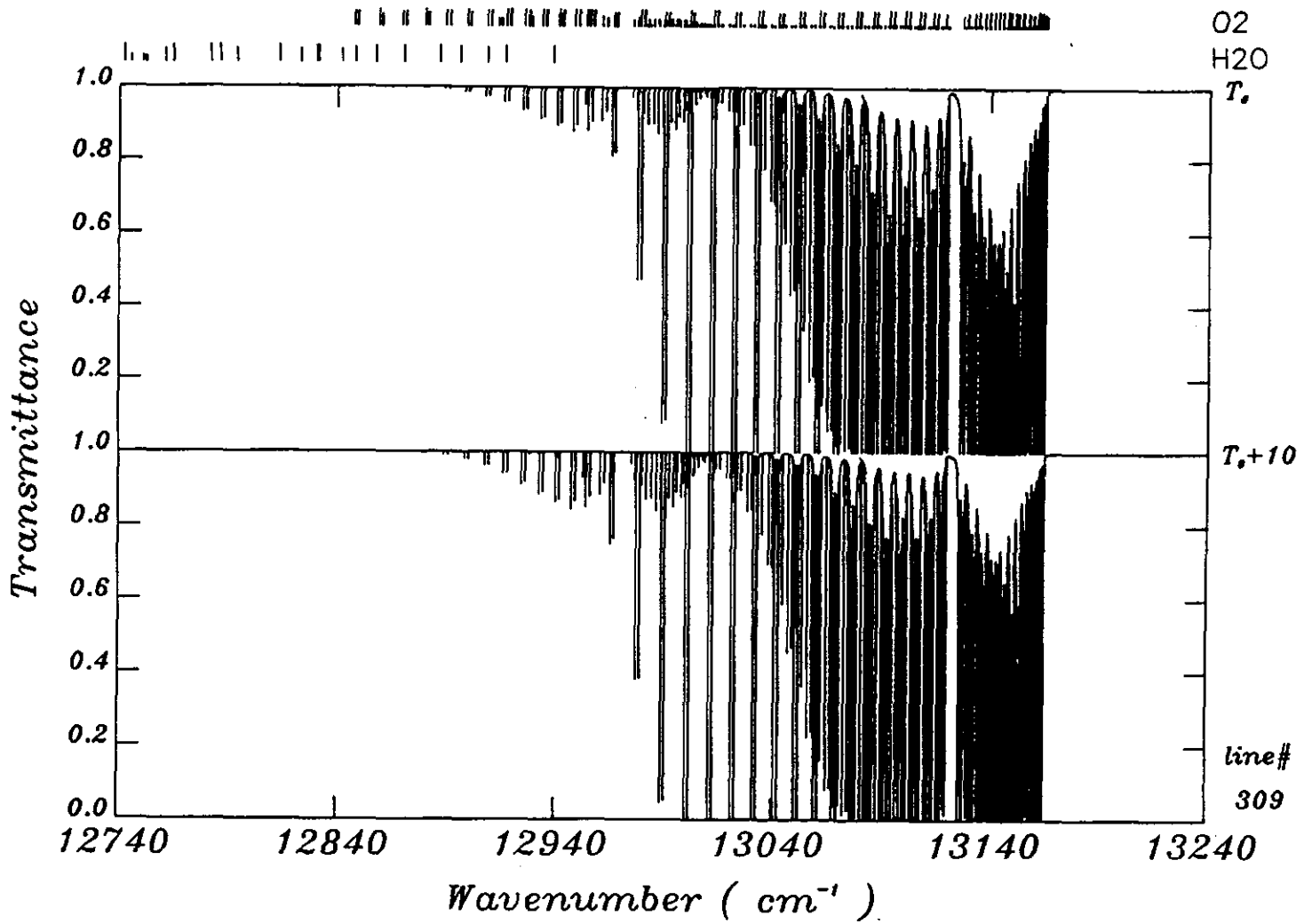


Fig.6 Transmittance comparison between standard temperature (T_0) and 10 degree increased temperature (T_0 + 10) at a tangent altitude of 20 km.

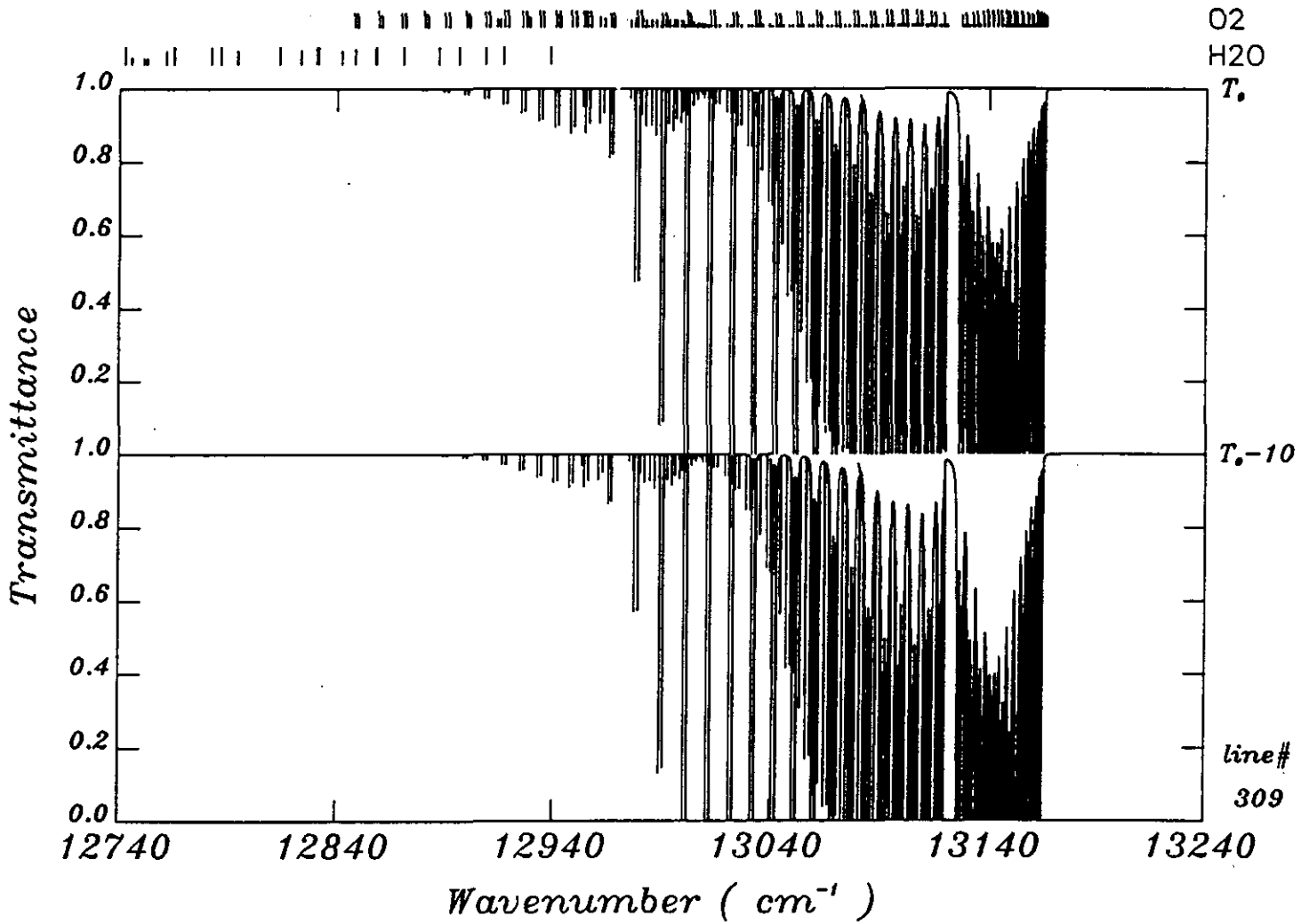


Fig.7 Transmittance comparison between standard temperature (T_0) and 10 degree decreased temperature (T_0 - 10) at a tangent altitude of 20 km.

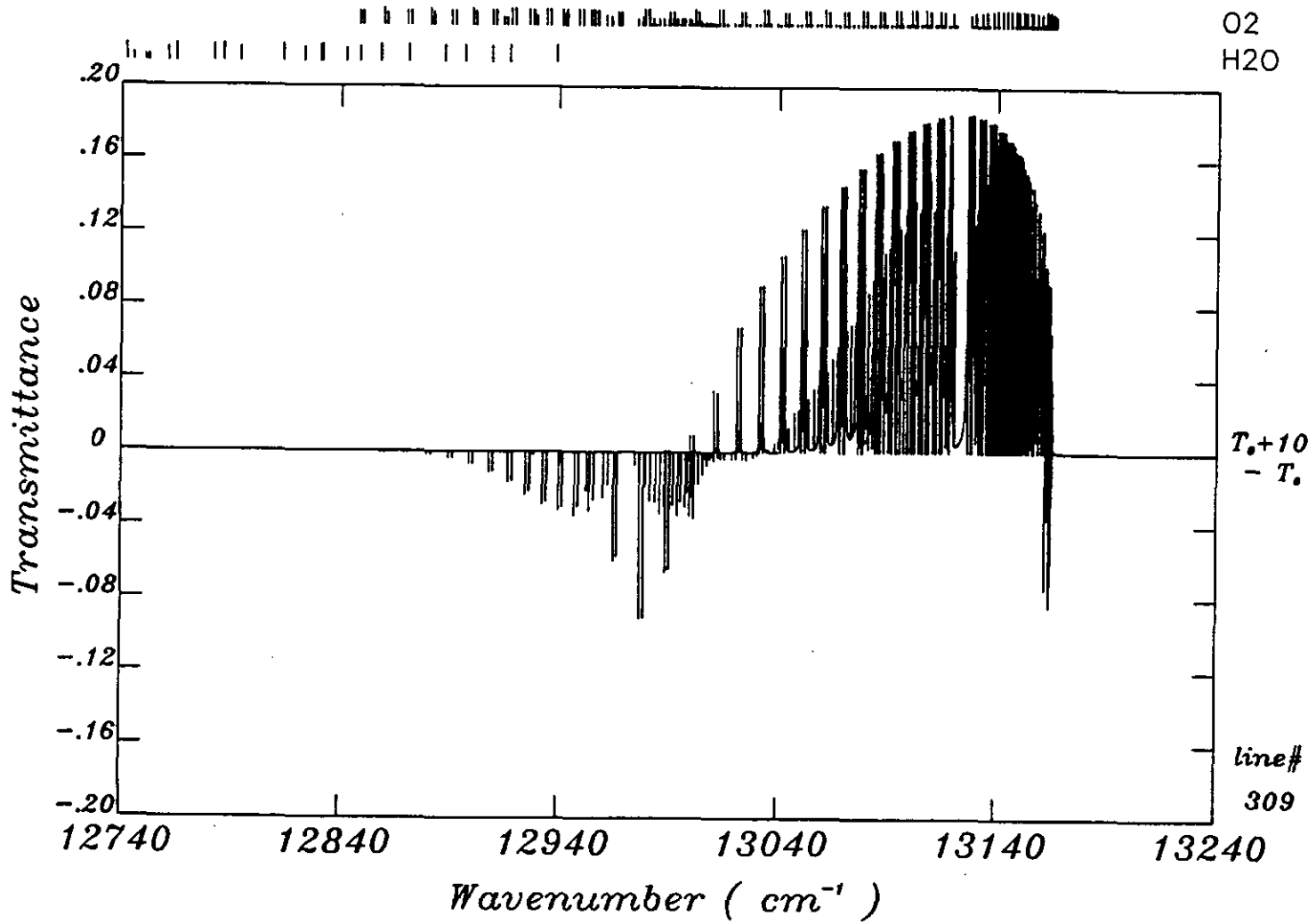


Fig.8 Transmittance difference between standard temperature (To) and 10 degree increased temperature (To + 10) at a tangent altitude of 20 km.

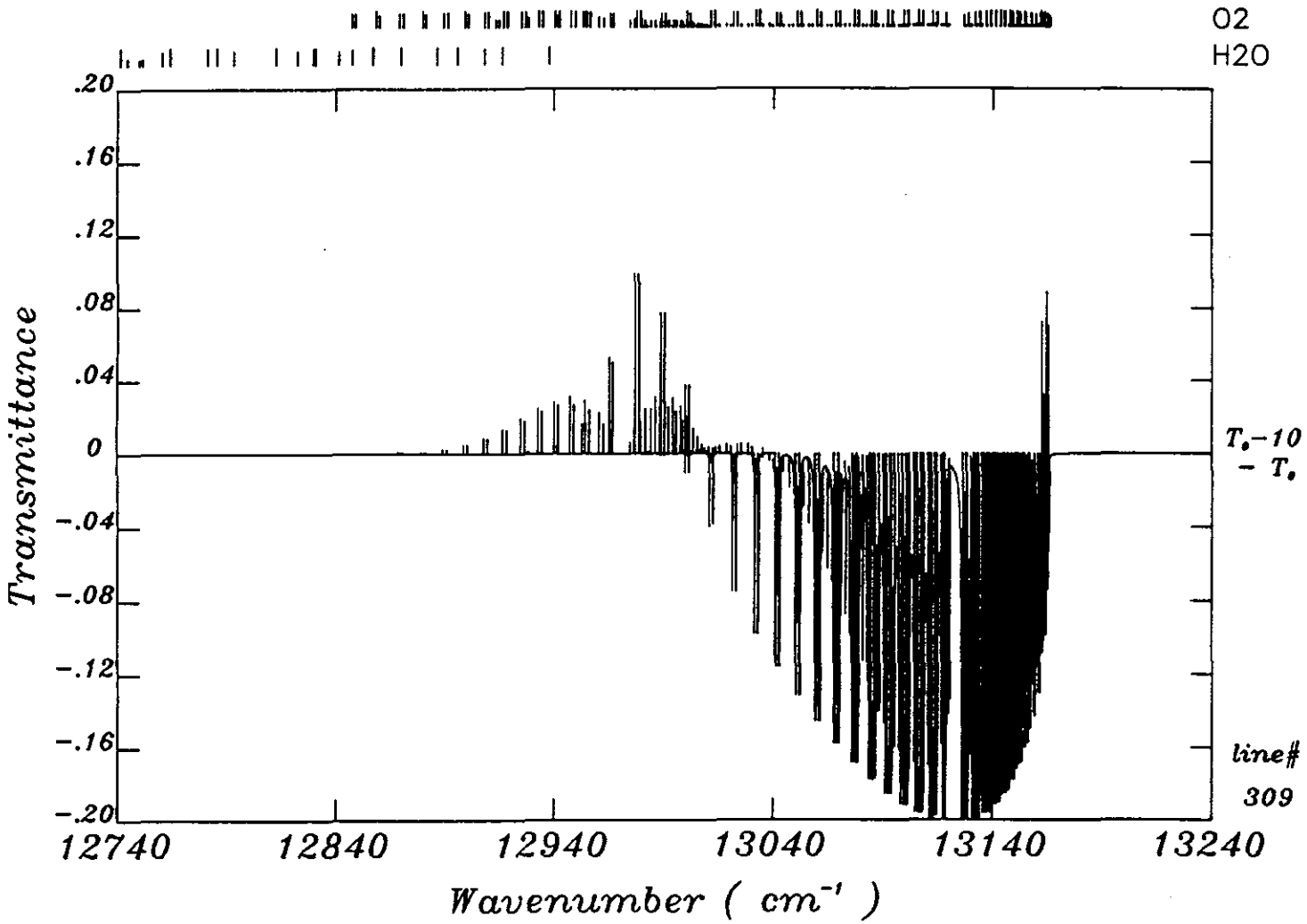


Fig.9 Transmittance difference between standard temperature (T_0) and 10 degree decreased temperature (T_0 - 10) at a tangent altitude of 20 km.

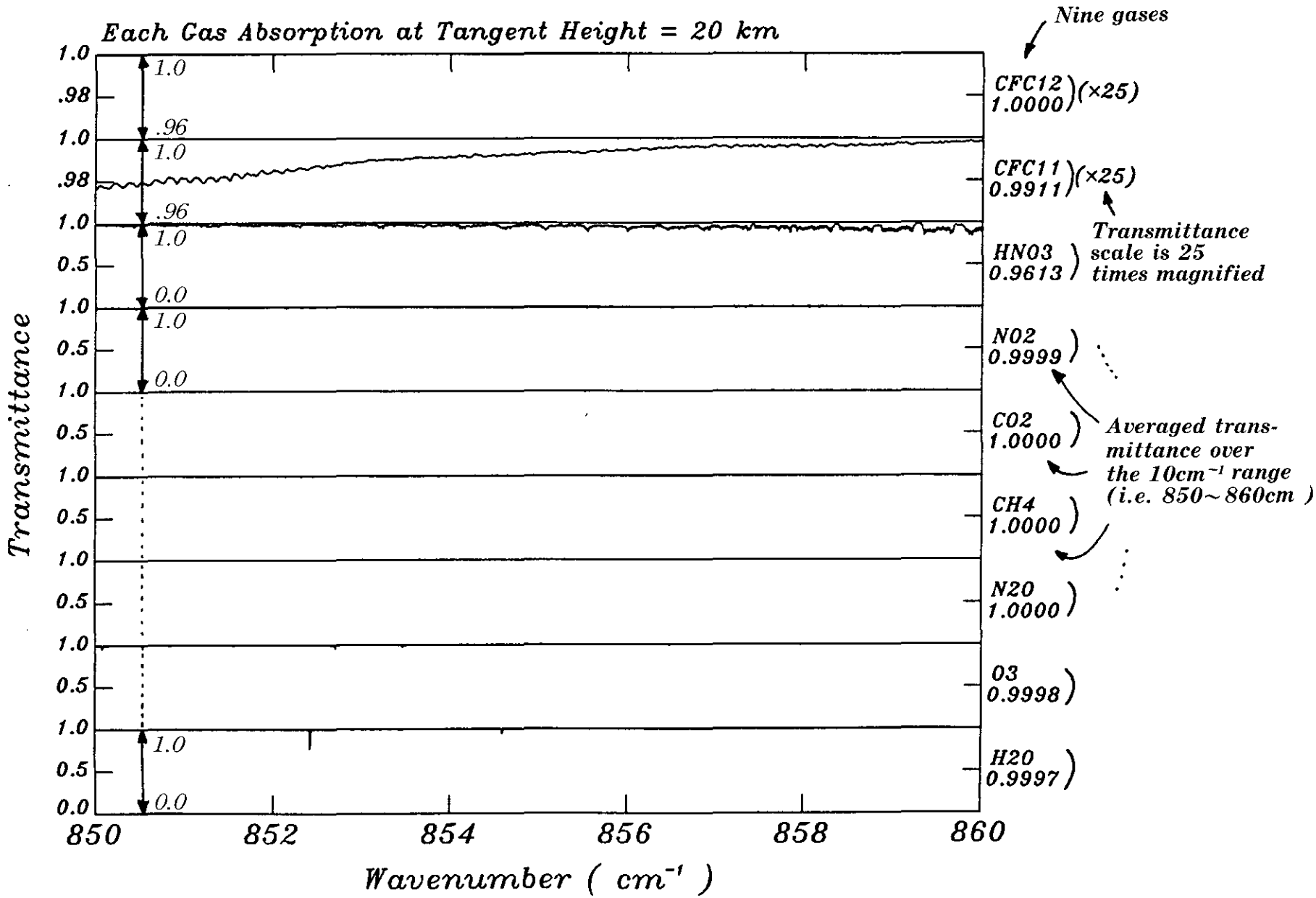
Table 1-1 Atmospheric Model Profiles (1)

Z(km)	P(mb)	T(K)	H2O	CO2	O3	N2O	CH4	NO2	HNO3	CFC-11	CFC-12
50.0	0.58	244.53	6.41E-6	3.3E-4	1.82E-6	3.63E-10	9.19E-8	2.60E-10	4.5E-12	1.0E-13	1.0E-13
49.5	0.62	246.00	6.42E-6	3.3E-4	1.96E-6	3.90E-10	9.32E-8	3.10E-10	5.9E-12	1.0E-13	1.0E-13
49.0	0.67	247.48	6.43E-6	3.3E-4	2.09E-6	4.17E-10	9.45E-8	3.60E-10	7.6E-12	1.0E-13	1.0E-13
48.5	0.72	248.95	6.44E-6	3.3E-4	2.22E-6	4.44E-10	9.58E-8	4.30E-10	1.0E-11	1.0E-13	1.0E-13
48.0	0.77	250.43	6.46E-6	3.3E-4	2.35E-6	4.71E-10	9.71E-8	5.10E-10	1.3E-11	1.0E-13	1.0E-13
47.5	0.82	251.90	6.47E-6	3.3E-4	2.48E-6	4.98E-10	9.83E-8	6.00E-10	1.7E-11	1.0E-13	1.0E-13
47.0	0.88	253.37	6.48E-6	3.3E-4	2.61E-6	5.25E-10	9.96E-8	7.10E-10	2.1E-11	1.0E-13	1.0E-13
46.5	0.93	254.85	6.49E-6	3.3E-4	2.75E-6	5.52E-10	1.01E-7	8.50E-10	2.7E-11	1.0E-13	1.0E-13
46.0	1.00	256.32	6.50E-6	3.3E-4	2.88E-6	5.79E-10	1.02E-7	1.00E-9	3.4E-11	1.0E-13	1.0E-12
45.5	1.07	254.92	6.50E-6	3.3E-4	2.95E-6	7.23E-10	1.06E-7	1.20E-9	4.6E-11	1.0E-13	1.2E-12
45.0	1.14	253.44	6.49E-6	3.3E-4	3.02E-6	8.70E-10	1.09E-7	1.40E-9	6.1E-11	1.0E-13	1.3E-12
44.5	1.22	251.96	6.49E-6	3.3E-4	3.09E-6	1.02E-9	1.12E-7	1.70E-9	8.2E-11	1.0E-13	1.6E-12
44.0	1.30	250.48	6.48E-6	3.3E-4	3.17E-6	1.16E-9	1.16E-7	2.10E-9	1.1E-10	1.0E-13	1.8E-12
43.5	1.39	249.00	6.48E-6	3.3E-4	3.24E-6	1.31E-9	1.19E-7	2.40E-9	1.3E-10	1.0E-13	2.0E-12
43.0	1.49	247.52	6.47E-6	3.3E-4	3.31E-6	1.46E-9	1.22E-7	2.70E-9	1.5E-10	1.0E-13	2.2E-12
42.5	1.60	246.04	6.46E-6	3.3E-4	3.38E-6	1.60E-9	1.26E-7	3.10E-9	1.7E-10	1.0E-13	2.4E-12
42.0	1.71	244.56	6.46E-6	3.3E-4	3.45E-6	1.75E-9	1.29E-7	3.50E-9	2.0E-10	1.0E-13	2.7E-12
41.5	1.83	243.08	6.45E-6	3.3E-4	3.53E-6	1.90E-9	1.33E-7	3.90E-9	2.4E-10	1.0E-13	3.1E-12
41.0	1.97	241.60	6.44E-6	3.3E-4	3.60E-6	2.04E-9	1.36E-7	4.30E-9	2.8E-10	1.0E-13	3.5E-12
40.5	2.11	240.44	6.43E-6	3.3E-4	3.70E-6	2.62E-9	1.45E-7	4.70E-9	3.4E-10	1.0E-13	4.0E-12
40.0	2.26	239.39	6.42E-6	3.3E-4	3.81E-6	3.34E-9	1.56E-7	5.20E-9	4.0E-10	1.0E-13	4.5E-12
39.5	2.43	238.34	6.41E-6	3.3E-4	3.92E-6	4.06E-9	1.67E-7	5.60E-9	4.6E-10	1.0E-13	5.2E-12
39.0	2.61	237.28	6.39E-6	3.3E-4	4.03E-6	4.77E-9	1.78E-7	6.10E-9	5.3E-10	1.0E-13	6.0E-12
38.5	2.80	236.23	6.38E-6	3.3E-4	4.14E-6	5.49E-9	1.88E-7	6.60E-9	6.1E-10	1.0E-13	6.9E-12
38.0	3.01	235.17	6.36E-6	3.3E-4	4.25E-6	6.21E-9	1.99E-7	7.20E-9	7.0E-10	1.0E-13	8.0E-12
37.5	3.23	234.12	6.35E-6	3.3E-4	4.36E-6	6.93E-9	2.10E-7	7.60E-9	8.0E-10	1.0E-13	8.9E-12
37.0	3.47	233.06	6.34E-6	3.3E-4	4.47E-6	7.64E-9	2.21E-7	8.00E-9	9.2E-10	1.0E-13	9.8E-12
36.5	3.74	232.01	6.32E-6	3.3E-4	4.58E-6	8.36E-9	2.32E-7	8.50E-9	1.0E-9	1.0E-13	1.1E-11
36.0	4.02	230.96	6.31E-6	3.3E-4	4.69E-6	9.08E-9	2.43E-7	9.00E-9	1.2E-9	1.0E-13	1.2E-11
35.5	4.32	229.90	6.30E-6	3.3E-4	4.80E-6	9.80E-9	2.54E-7	9.00E-9	1.4E-9	1.0E-13	1.4E-11
35.0	4.66	228.85	6.28E-6	3.3E-4	4.91E-6	1.05E-8	2.64E-7	9.05E-9	1.6E-9	1.0E-13	1.6E-11
34.5	5.01	227.73	6.27E-6	3.3E-4	5.02E-6	1.14E-8	2.76E-7	9.10E-9	1.8E-9	1.0E-13	1.8E-11
34.0	5.40	225.28	6.19E-6	3.3E-4	5.08E-6	1.58E-8	3.14E-7	9.10E-9	2.1E-9	1.0E-13	2.1E-11
33.5	5.83	222.82	6.12E-6	3.3E-4	5.13E-6	2.02E-8	3.51E-7	9.00E-9	2.3E-9	1.0E-13	2.3E-11
33.0	6.29	220.37	6.05E-6	3.3E-4	5.19E-6	2.47E-8	3.88E-7	8.95E-9	2.6E-9	1.0E-13	2.6E-11
32.5	6.79	217.92	5.98E-6	3.3E-4	5.24E-6	2.91E-8	4.26E-7	8.90E-9	2.8E-9	1.0E-13	2.8E-11
32.0	7.34	215.46	5.91E-6	3.3E-4	5.30E-6	3.35E-8	4.63E-7	8.80E-9	3.1E-9	1.0E-13	3.1E-11
31.5	7.95	213.01	5.83E-6	3.3E-4	5.35E-6	3.79E-8	5.00E-7	8.40E-9	3.3E-9	3.2E-13	3.5E-11
31.0	8.61	210.56	5.76E-6	3.3E-4	5.41E-6	4.24E-8	5.38E-7	8.00E-9	3.5E-9	1.0E-12	3.9E-11
30.5	9.33	208.10	5.69E-6	3.3E-4	5.46E-6	4.68E-8	5.75E-7	7.65E-9	3.8E-9	1.2E-12	4.4E-11
30.0	10.13	205.94	5.61E-6	3.3E-4	5.53E-6	5.23E-8	6.13E-7	7.30E-9	4.0E-9	1.5E-12	5.0E-11

Table 1-2 Atmospheric Model Profiles (2)

Z(km)	P(mb)	T(K)	H2O	CO2	O3	N2O	CH4	NO2	HNO3	CFC-11	CFC-12
30.0	10.13	205.94	5.61E-6	3.3E-4	5.53E-6	5.23E-8	6.13E-7	7.30E-9	4.0E-9	1.5E-12	5.0E-11
29.5	11.00	205.24	5.52E-6	3.3E-4	5.64E-6	6.37E-8	6.58E-7	6.80E-9	4.1E-9	2.0E-12	5.4E-11
29.0	11.95	204.55	5.42E-6	3.3E-4	5.76E-6	7.50E-8	7.02E-7	6.30E-9	4.2E-9	2.6E-12	5.9E-11
28.5	12.98	203.85	5.32E-6	3.3E-4	5.88E-6	8.64E-8	7.46E-7	5.90E-9	4.4E-9	3.5E-12	6.4E-11
28.0	14.11	203.16	5.22E-6	3.3E-4	5.99E-6	9.77E-8	7.91E-7	5.50E-9	4.5E-9	4.6E-12	7.0E-11
27.5	15.34	202.46	5.12E-6	3.3E-4	6.11E-6	1.09E-7	8.35E-7	5.10E-9	4.6E-9	6.0E-12	7.5E-11
27.0	16.68	201.77	5.03E-6	3.3E-4	6.23E-6	1.20E-7	8.79E-7	4.70E-9	4.7E-9	7.7E-12	8.0E-11
26.5	18.14	201.07	4.93E-6	3.3E-4	6.34E-6	1.32E-7	9.24E-7	4.30E-9	4.8E-9	1.0E-11	8.6E-11
26.0	19.74	200.38	4.83E-6	3.3E-4	6.46E-6	1.43E-7	9.68E-7	4.00E-9	4.9E-9	1.3E-11	9.2E-11
25.5	21.48	200.72	4.75E-6	3.3E-4	6.21E-6	1.52E-7	9.97E-7	3.60E-9	4.9E-9	1.6E-11	9.8E-11
25.0	23.37	201.23	4.68E-6	3.3E-4	5.90E-6	1.61E-7	1.02E-6	3.20E-9	5.0E-9	1.9E-11	1.1E-10
24.5	25.43	201.74	4.60E-6	3.3E-4	5.60E-6	1.70E-7	1.05E-6	2.90E-9	4.9E-9	2.4E-11	1.1E-10
24.0	27.65	202.25	4.53E-6	3.3E-4	5.29E-6	1.79E-7	1.08E-6	2.60E-9	4.9E-9	2.9E-11	1.2E-10
23.5	30.07	202.76	4.46E-6	3.3E-4	4.98E-6	1.87E-7	1.10E-6	2.30E-9	4.7E-9	3.3E-11	1.22E-10
23.0	32.69	203.27	4.38E-6	3.3E-4	4.68E-6	1.96E-7	1.13E-6	2.00E-9	4.5E-9	3.8E-11	1.25E-10
22.5	35.53	203.78	4.31E-6	3.3E-4	4.37E-6	2.05E-7	1.16E-6	1.80E-9	4.3E-9	4.4E-11	1.27E-10
22.0	38.62	204.29	4.23E-6	3.3E-4	4.06E-6	2.14E-7	1.18E-6	1.60E-9	4.1E-9	5.0E-11	1.3E-10
21.5	41.96	204.79	4.17E-6	3.3E-4	3.78E-6	2.20E-7	1.20E-6	1.40E-9	3.8E-9	5.7E-11	1.35E-10
21.0	45.58	205.27	4.12E-6	3.3E-4	3.52E-6	2.25E-7	1.22E-6	1.30E-9	3.6E-9	6.5E-11	1.4E-10
20.5	49.51	205.76	4.07E-6	3.3E-4	3.26E-6	2.30E-7	1.23E-6	1.10E-9	3.3E-9	7.0E-11	1.45E-10
20.0	53.76	206.25	4.01E-6	3.3E-4	3.00E-6	2.35E-7	1.25E-6	1.00E-9	3.1E-9	7.5E-11	1.5E-10
19.5	58.37	206.73	3.96E-6	3.3E-4	2.73E-6	2.41E-7	1.27E-6	8.70E-10	2.8E-9	8.1E-11	1.55E-10
19.0	63.37	207.22	3.91E-6	3.3E-4	2.47E-6	2.46E-7	1.28E-6	7.60E-10	2.5E-9	8.7E-11	1.6E-10
18.5	68.78	207.71	3.86E-6	3.3E-4	2.21E-6	2.51E-7	1.30E-6	6.65E-10	2.2E-9	8.9E-11	1.65E-10
18.0	74.63	208.20	3.83E-6	3.3E-4	2.14E-6	2.54E-7	1.31E-6	5.80E-10	2.0E-9	9.2E-11	1.7E-10
17.5	80.97	208.71	3.81E-6	3.3E-4	2.12E-6	2.56E-7	1.32E-6	4.40E-10	1.7E-9	1.05E-10	1.77E-10
17.0	87.84	209.21	3.79E-6	3.3E-4	2.09E-6	2.58E-7	1.33E-6	3.40E-10	1.4E-9	1.1E-10	1.84E-10
16.5	95.26	209.71	3.77E-6	3.3E-4	2.07E-6	2.61E-7	1.34E-6	2.60E-10	1.2E-9	1.15E-10	1.92E-10
16.0	103.30	210.80	5.37E-6	3.3E-4	2.03E-6	2.63E-7	1.35E-6	2.00E-10	1.0E-9	1.2E-10	2.0E-10
15.5	111.90	212.70	9.18E-6	3.3E-4	1.96E-6	2.65E-7	1.36E-6	1.40E-10	7.7E-10	1.22E-10	2.02E-10
15.0	121.20	214.59	1.30E-5	3.3E-4	1.90E-6	2.67E-7	1.37E-6	1.00E-10	6.0E-10	1.25E-10	2.05E-10
14.5	131.20	216.48	1.68E-5	3.3E-4	1.83E-6	2.69E-7	1.39E-6	7.10E-11	4.6E-10	1.27E-10	2.07E-10
14.0	141.80	218.38	2.06E-5	3.3E-4	1.76E-6	2.71E-7	1.40E-6	5.00E-11	3.6E-10	1.3E-10	2.1E-10
13.5	153.30	220.27	2.44E-5	3.3E-4	1.70E-6	2.73E-7	1.41E-6	3.40E-11	3.1E-10	1.31E-10	2.12E-10
13.0	165.50	222.16	2.83E-5	3.3E-4	1.63E-6	2.75E-7	1.42E-6	2.30E-11	2.6E-10	1.32E-10	2.15E-10
12.5	178.70	224.06	3.21E-5	3.3E-4	1.56E-6	2.77E-7	1.43E-6	1.60E-11	2.2E-10	1.33E-10	2.17E-10
12.0	192.70	225.95	3.59E-5	3.3E-4	1.49E-6	2.79E-7	1.45E-6	1.10E-11	1.9E-10	1.35E-10	2.2E-10
11.5	207.70	227.78	5.16E-5	3.3E-4	1.43E-6	2.81E-7	1.46E-6	1.00E-11	1.7E-10	1.36E-10	2.21E-10
11.0	223.80	229.56	7.83E-5	3.3E-4	1.37E-6	2.82E-7	1.47E-6	9.70E-12	1.5E-10	1.37E-10	2.22E-10
10.5	241.00	231.33	1.05E-4	3.3E-4	1.30E-6	2.84E-7	1.48E-6	9.10E-12	1.3E-10	1.38E-10	2.24E-10
10.0	259.30	233.10	1.32E-4	3.3E-4	1.24E-6	2.86E-7	1.49E-6	8.50E-12	1.2E-10	1.4E-10	2.25E-10

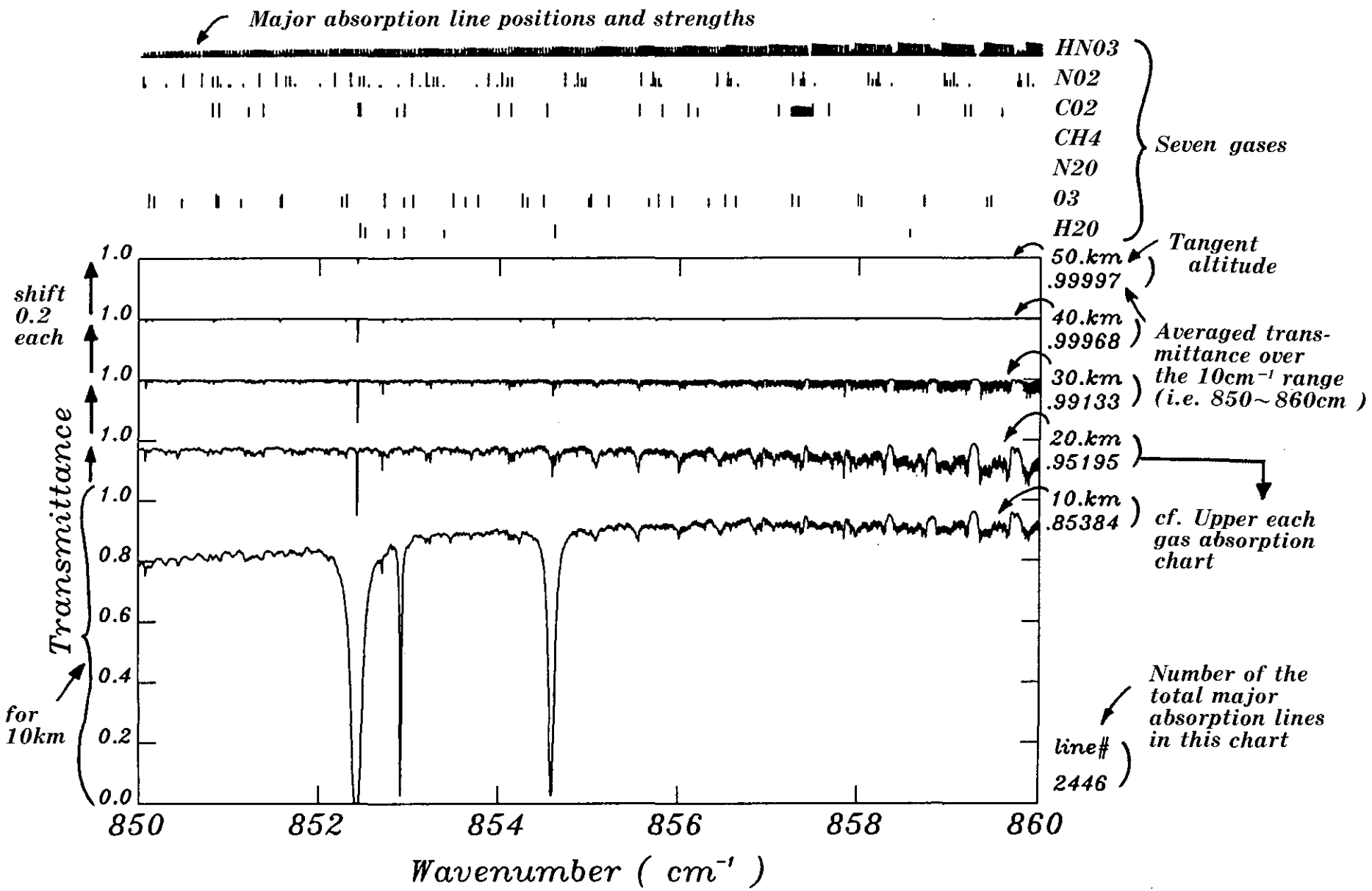
(Sample)

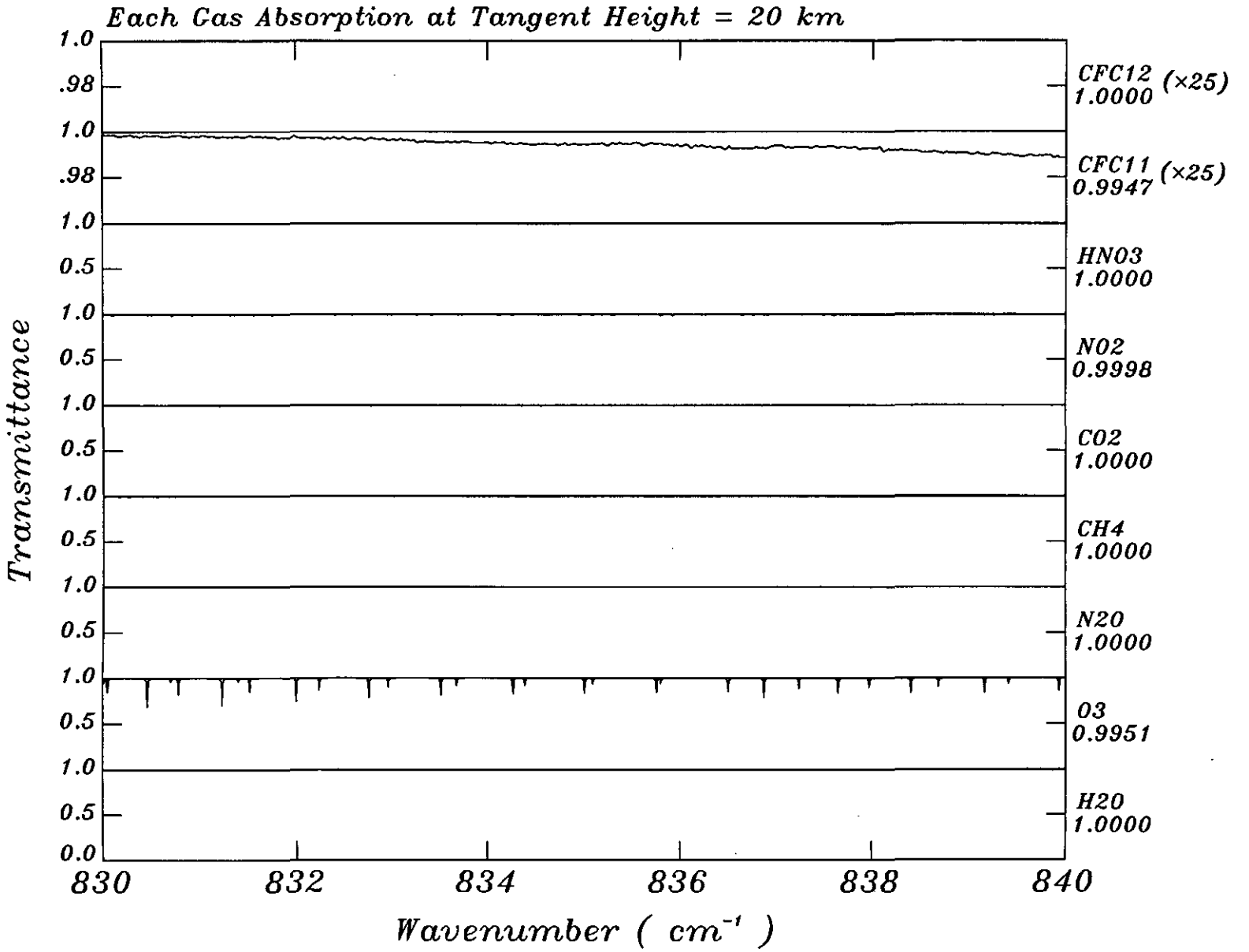

Each Gas Absorption at Tangent Height = 20 km
Nine gases
CFC12 1.0000 (×25)
CFC11 0.9911 (×25)
Transmittance scale is 25 times magnified
HNO3 0.9613
NO2 0.9999
CO2 1.0000
Averaged transmittance over the 10cm⁻¹ range (i.e. 850~860cm)
CH4 1.0000
N2O 1.0000
O3 0.9998
H2O 0.9997
Transmittance
Wavenumber (cm⁻¹)
850
852
854
856
858
860

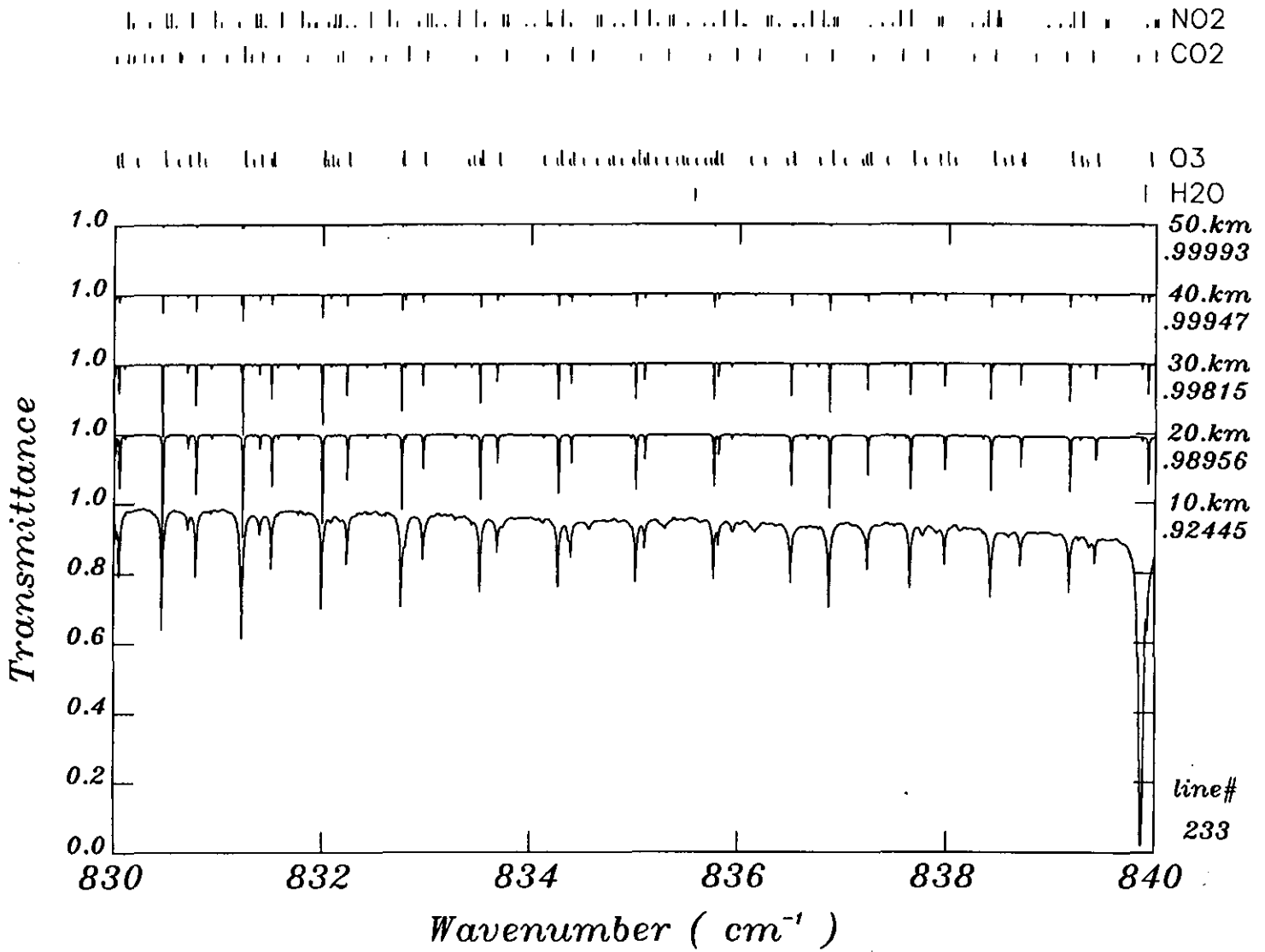
Atlas of the Infrared

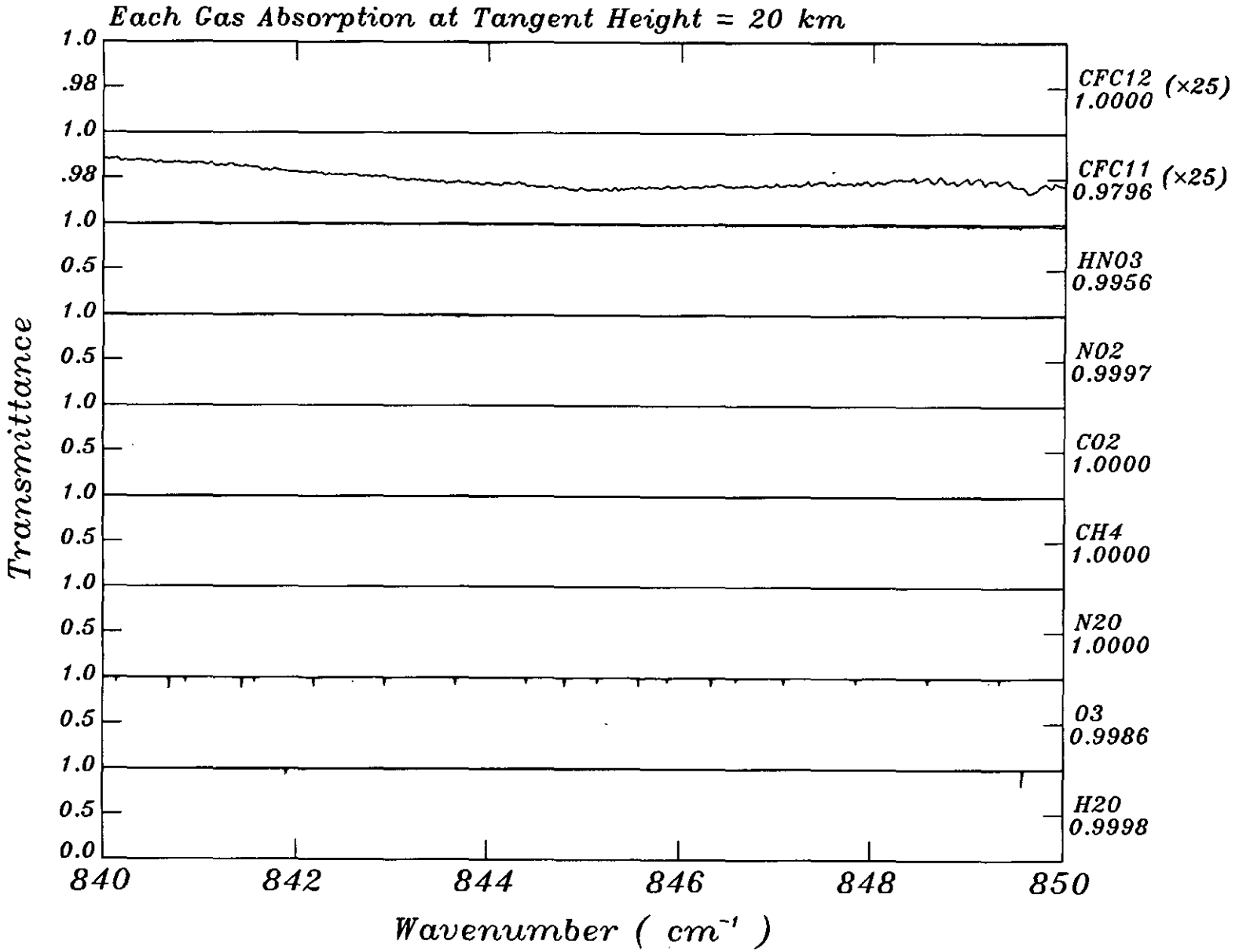
Absorption Spectrum

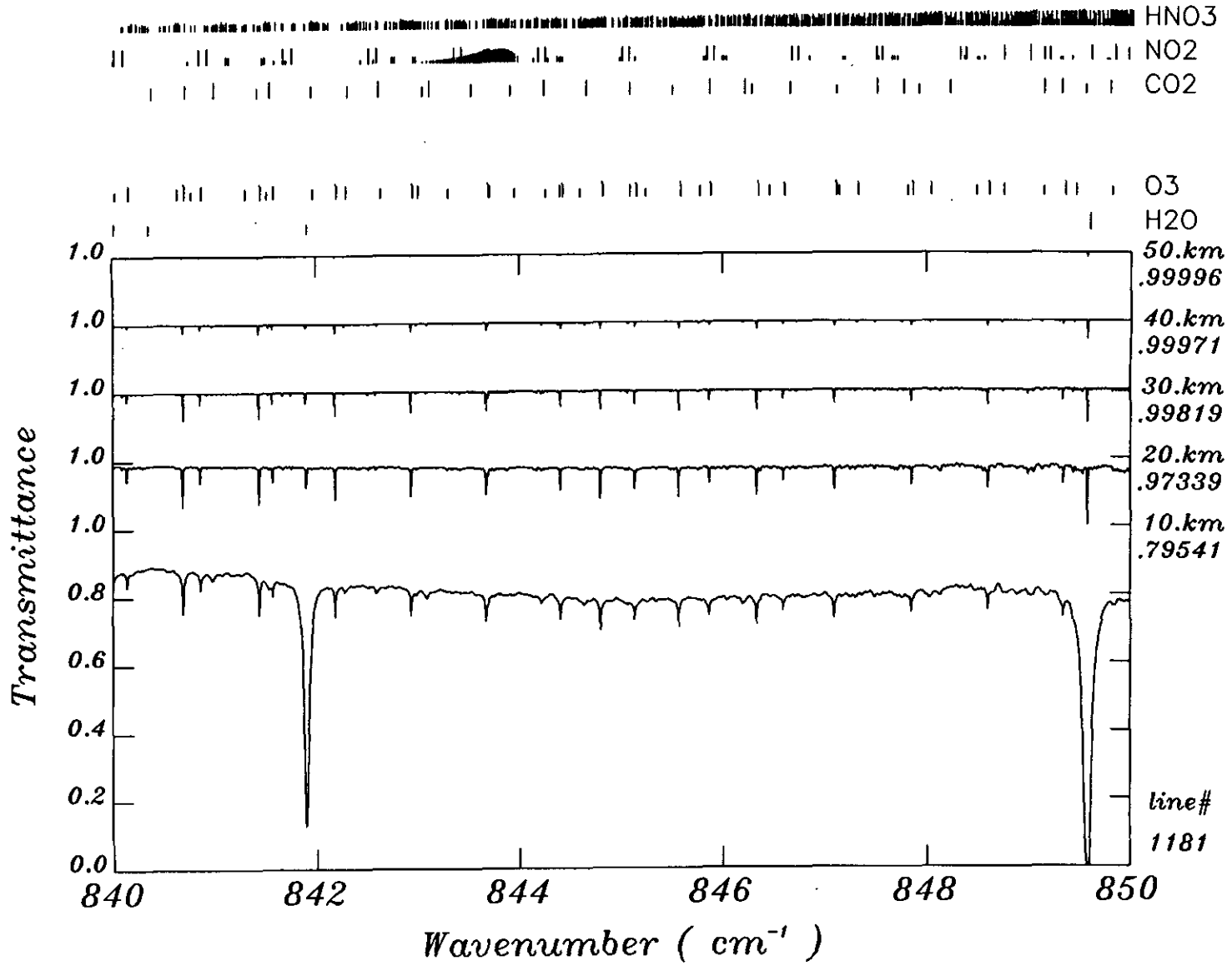
(Sample)

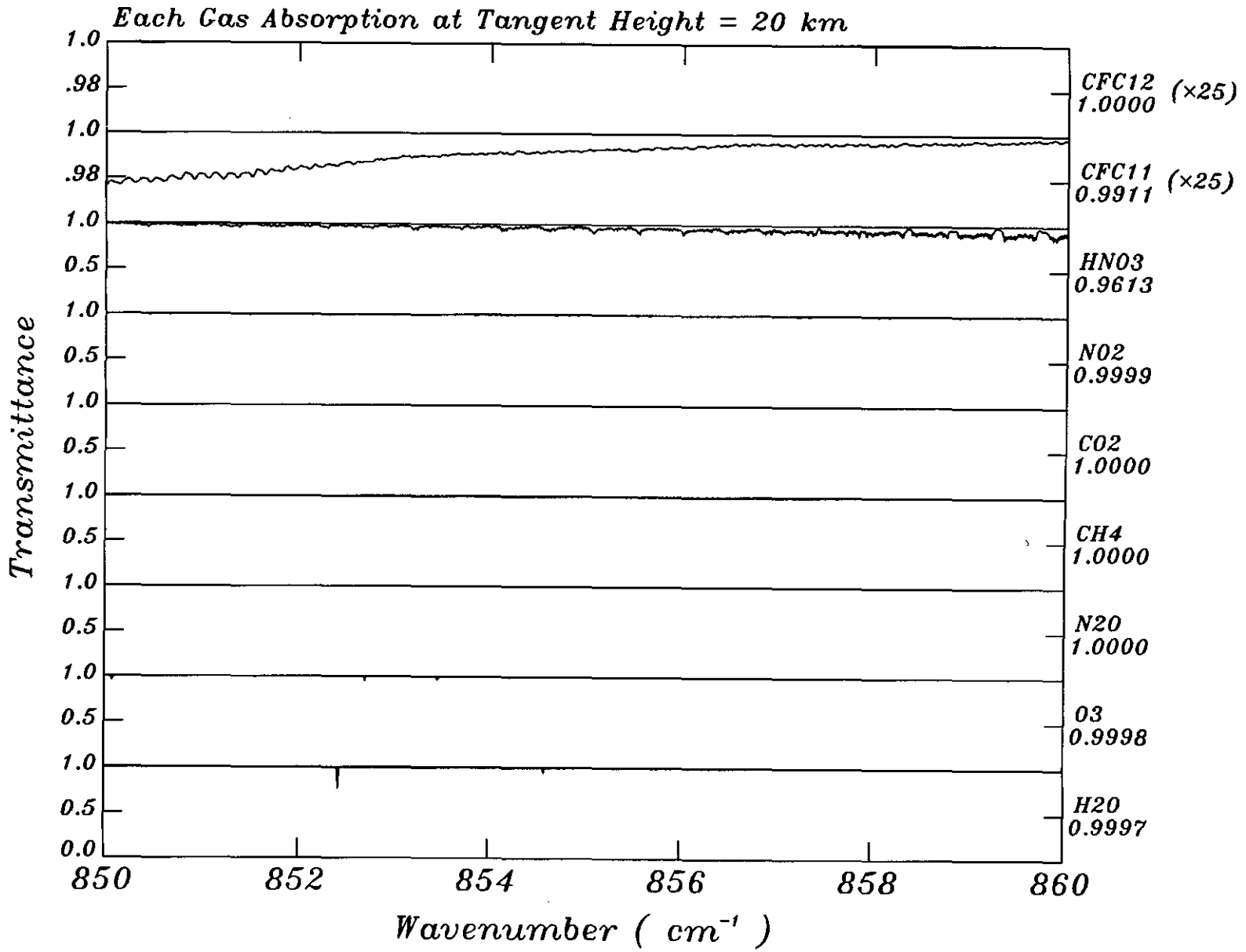

Major absorption line positions and strengths
HN03
N02
C02
CH4
N20
03
H20
Seven gases
Tangent altitude
50.km
.99997
40.km
.99968
30.km
.99133
20.km
.95195
10.km
.85384
Averaged transmittance over the 10cm⁻¹ range (i.e. 850~860cm)
cf. Upper each gas absorption chart
shift 0.2 each
Transmittance
for 10km
1.0
0.8
0.6
0.4
0.2
0.0
Number of the total major absorption lines in this chart
line#
2446
850
852
854
856
858
860
Wavenumber (cm⁻¹)

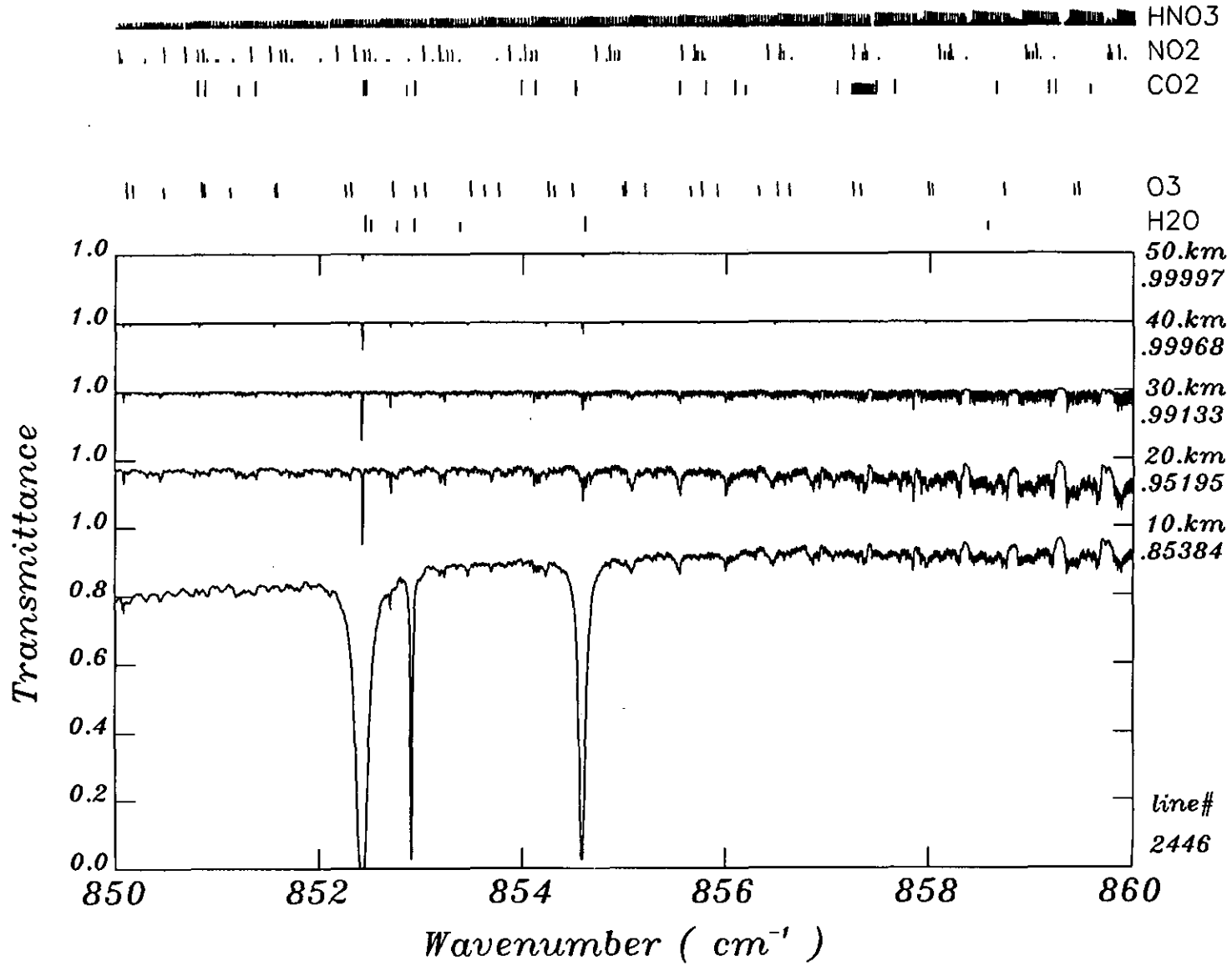

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
.98
1.0
.98
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
0.0
CFC12 (×25)
1.0000
CFC11 (×25)
0.9947
HNO3
1.0000
NO2
0.9998
CO2
1.0000
CH4
1.0000
N2O
1.0000
O3
0.9951
H2O
1.0000
830
832
834
836
838
840
Wavenumber (cm⁻¹)

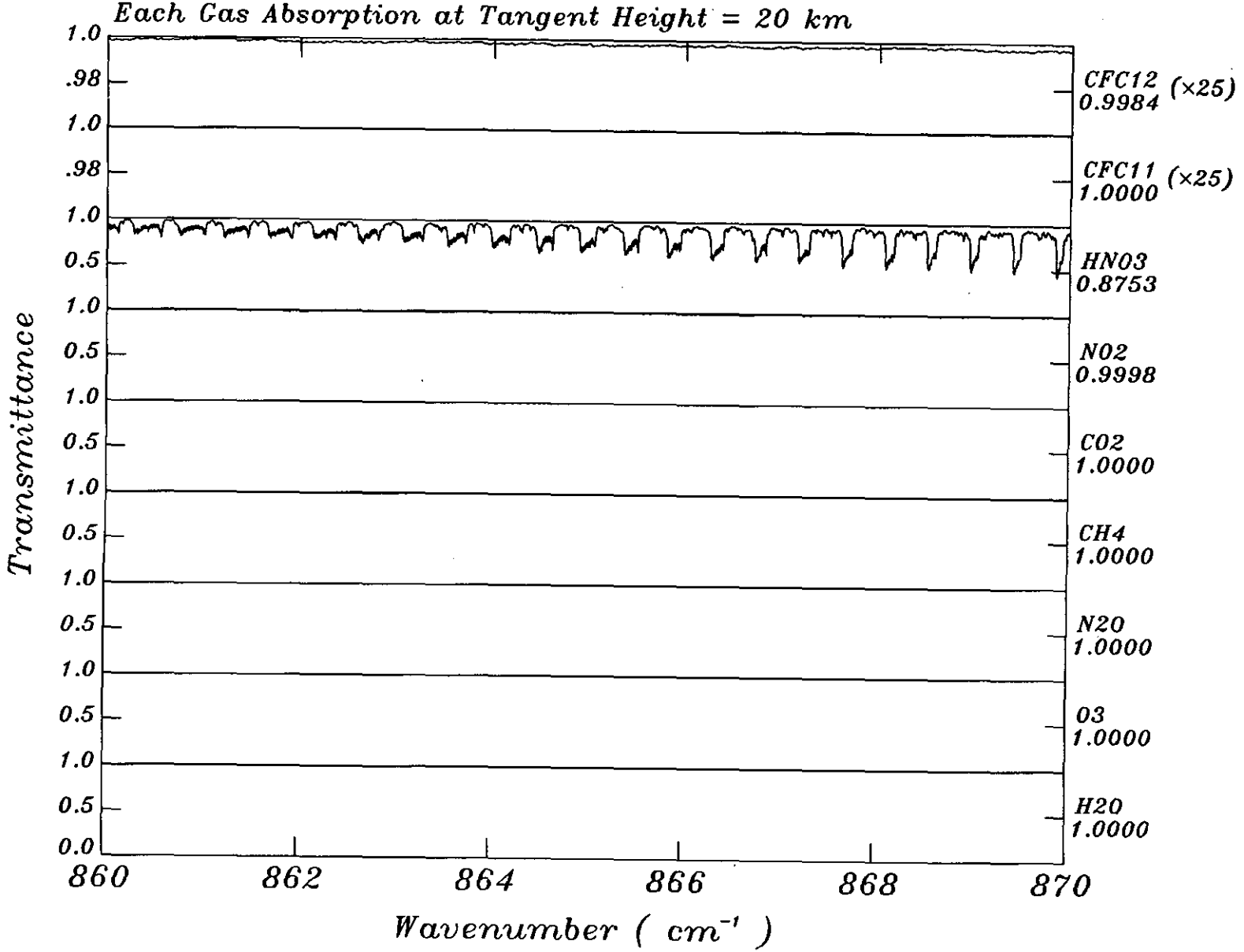

NO2
CO2
O3
H2O
50.km
.99993
40.km
.99947
30.km
.99815
20.km
.98956
10.km
.92445
line#
233
1.0
0.8
0.6
0.4
0.2
0.0
Transmittance
830
832
834
836
838
840
Wavenumber (cm⁻¹)

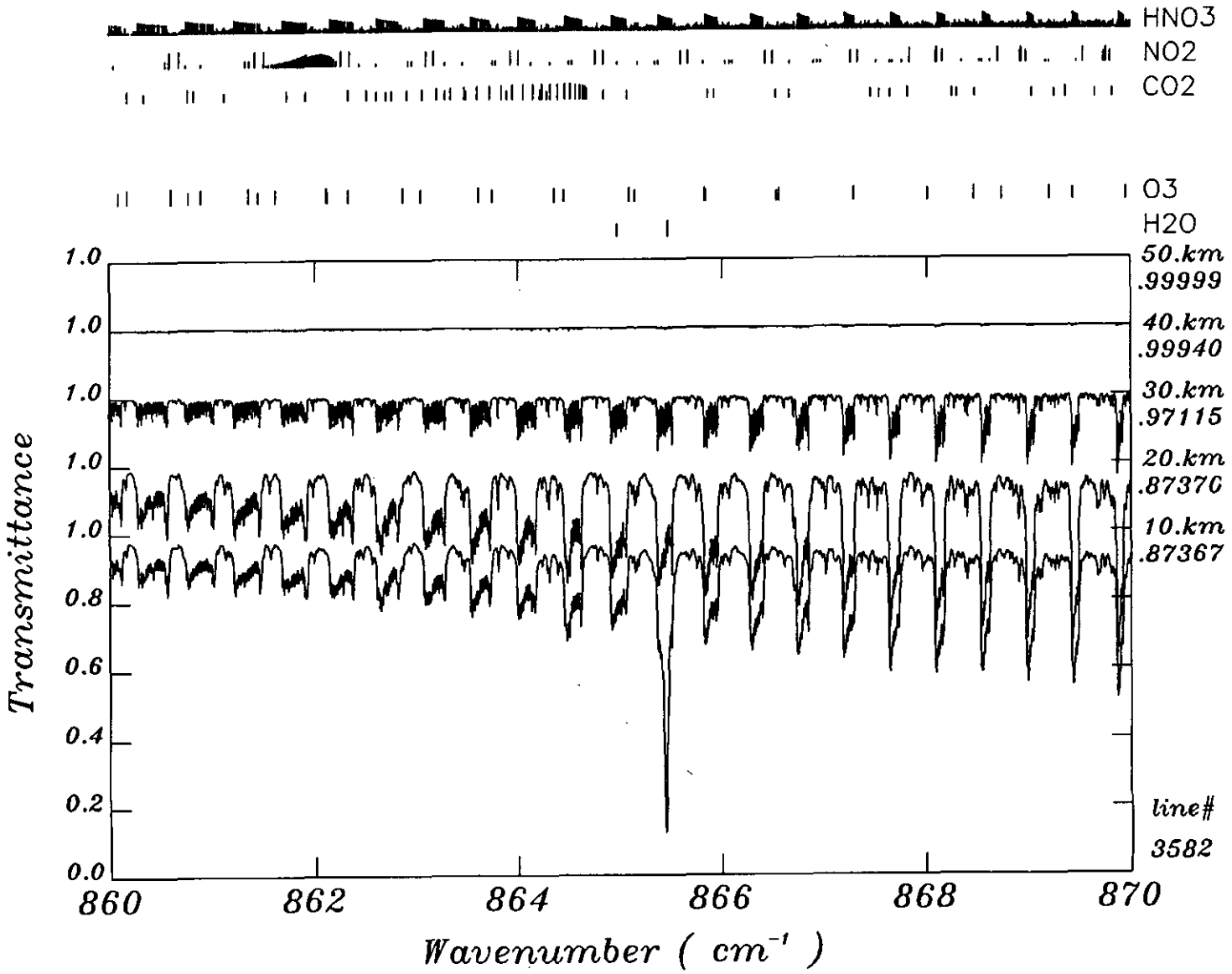

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
.98
1.0
.98
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
0.0
CFC12 (×25)
1.0000
CFC11 (×25)
0.9796
HN03
0.9956
N02
0.9997
C02
1.0000
CH4
1.0000
N20
1.0000
03
0.9986
H20
0.9998
840
842
844
846
848
850
Wavenumber (cm⁻¹)

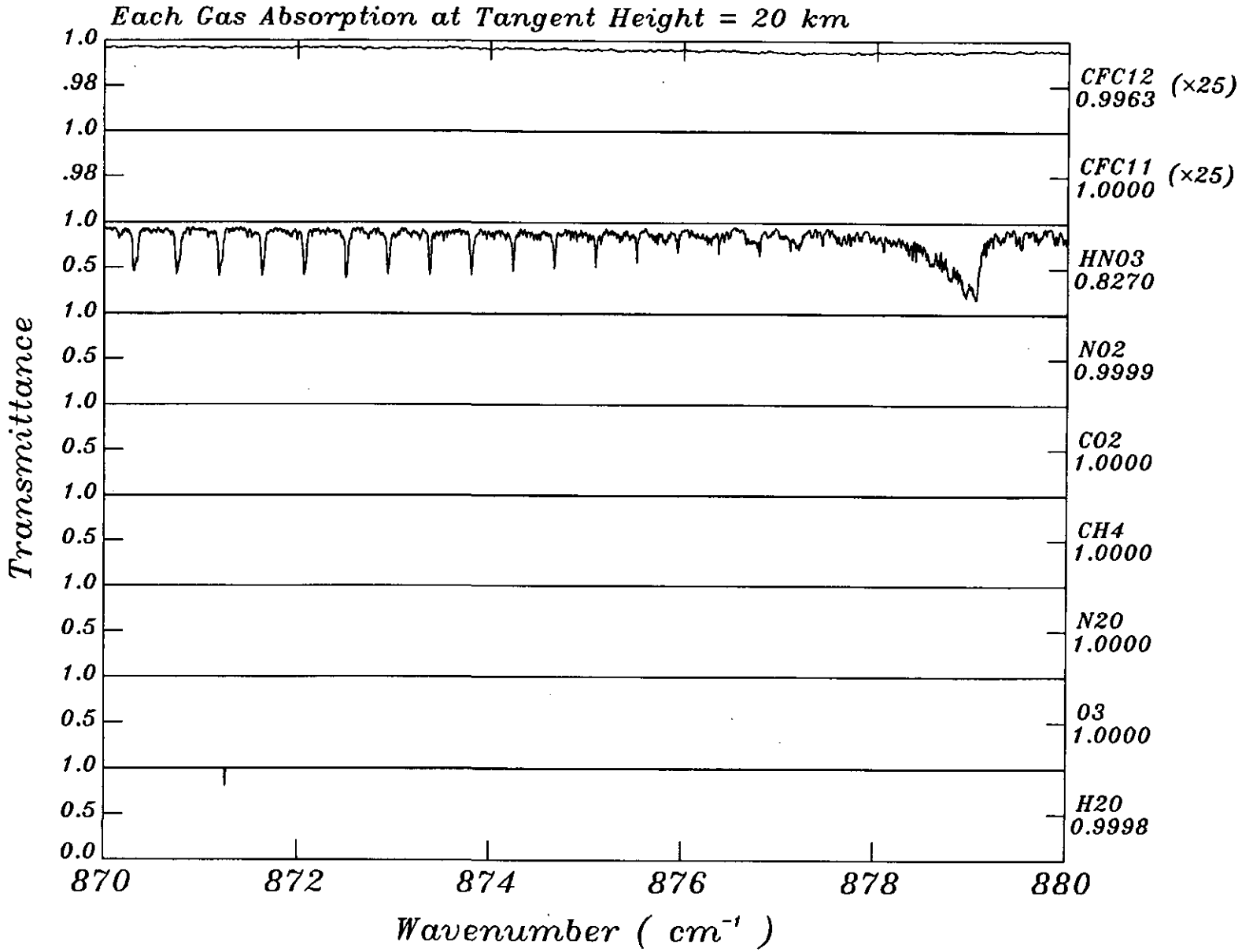

HNO3
NO2
CO2
O3
H2O
50.km
.99996
40.km
.99971
30.km
.99819
20.km
.97339
10.km
.79541
line#
1181
1.0
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
Transmittance
840
842
844
846
848
850
Wavenumber (cm⁻¹)

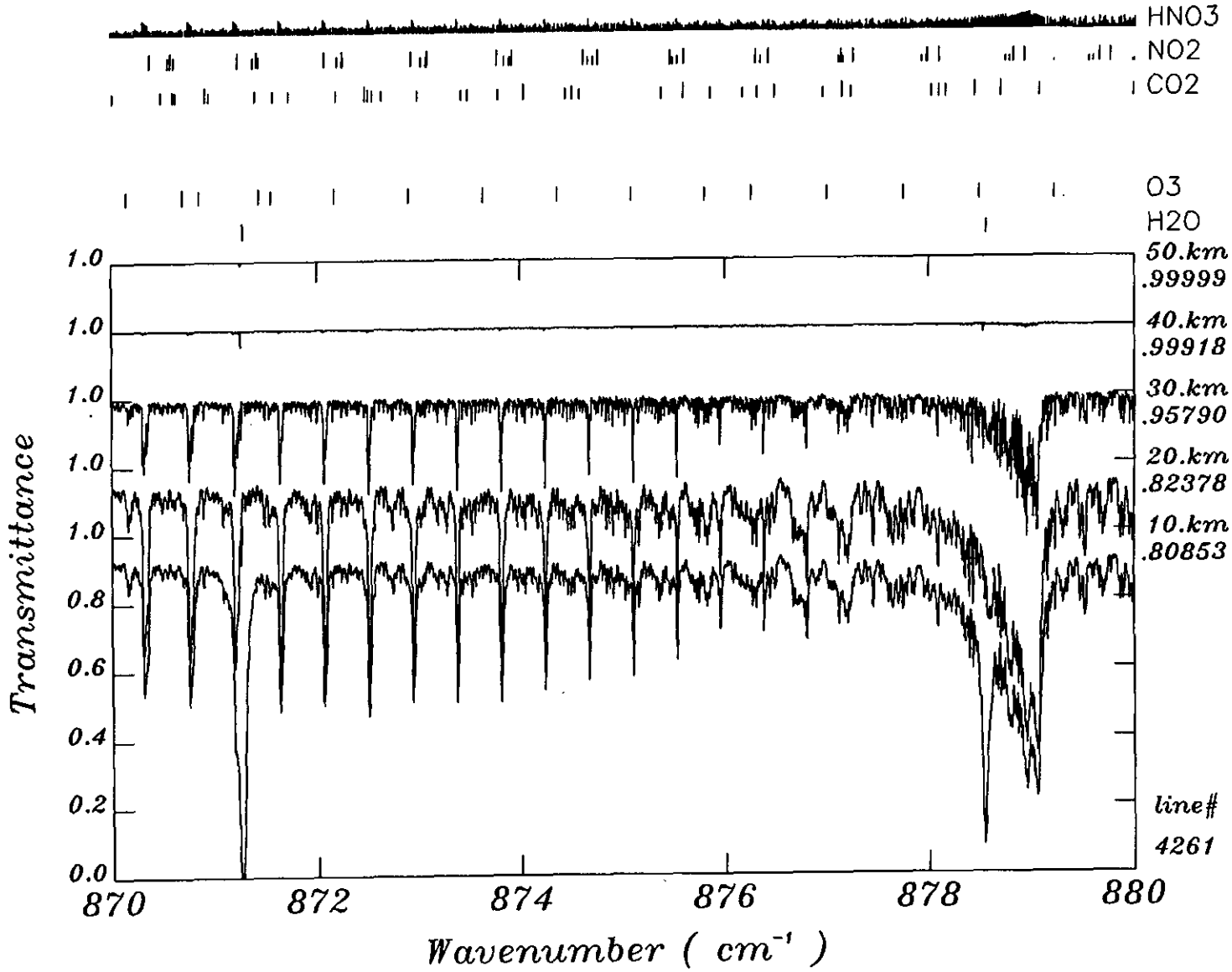

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
.98
1.0
.98
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
0.0
CFC12 (×25)
1.0000
CFC11 (×25)
0.9911
HNO3
0.9613
N02
0.9999
C02
1.0000
CH4
1.0000
N20
1.0000
03
0.9998
H20
0.9997
850
852
854
856
858
860
Wavenumber (cm⁻¹)

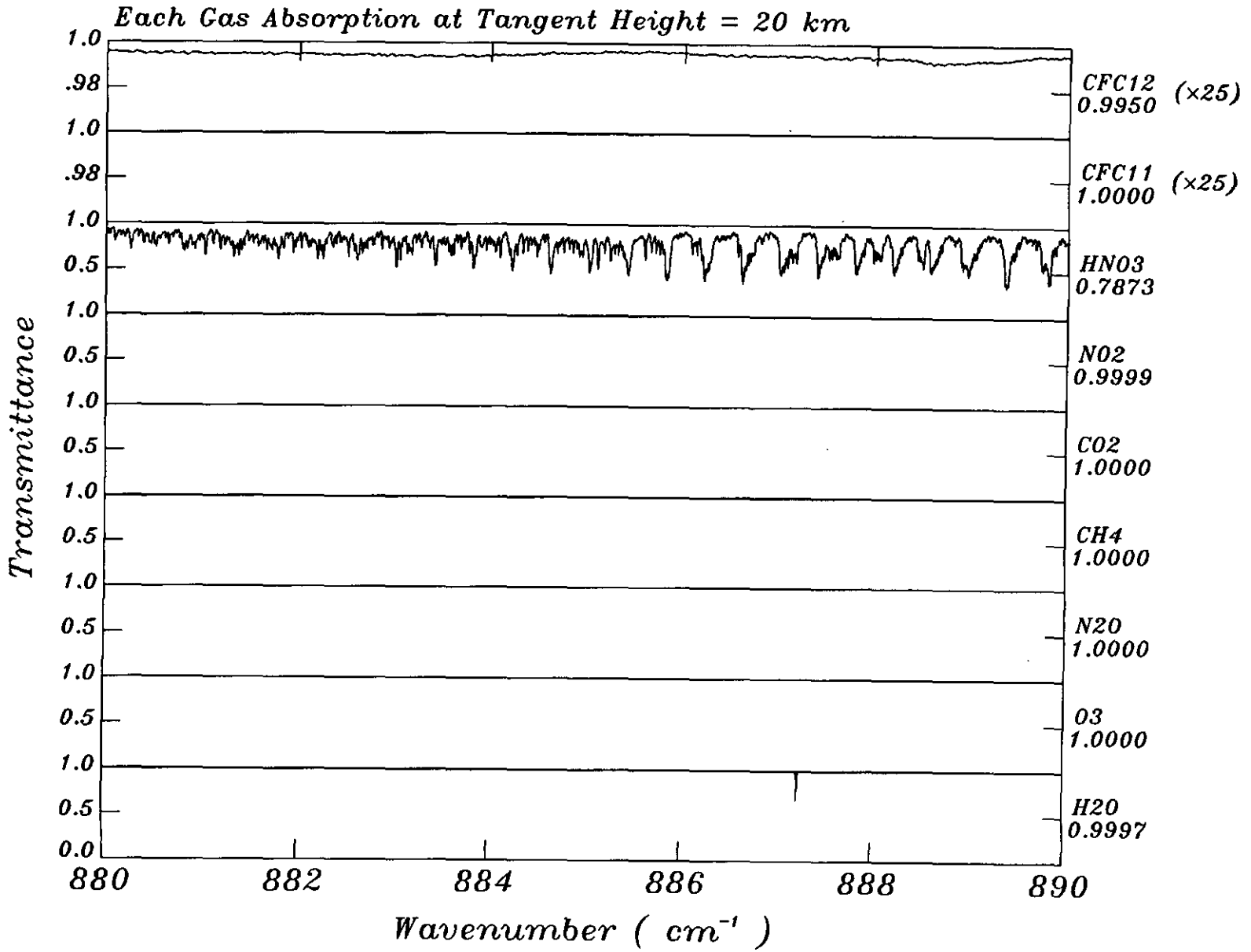

HNO3
NO2
CO2
O3
H2O
50.km
.99997
40.km
.99968
30.km
.99133
20.km
.95195
10.km
.85384
line#
2446
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
Transmittance
850
852
854
856
858
860
Wavenumber (cm⁻¹)

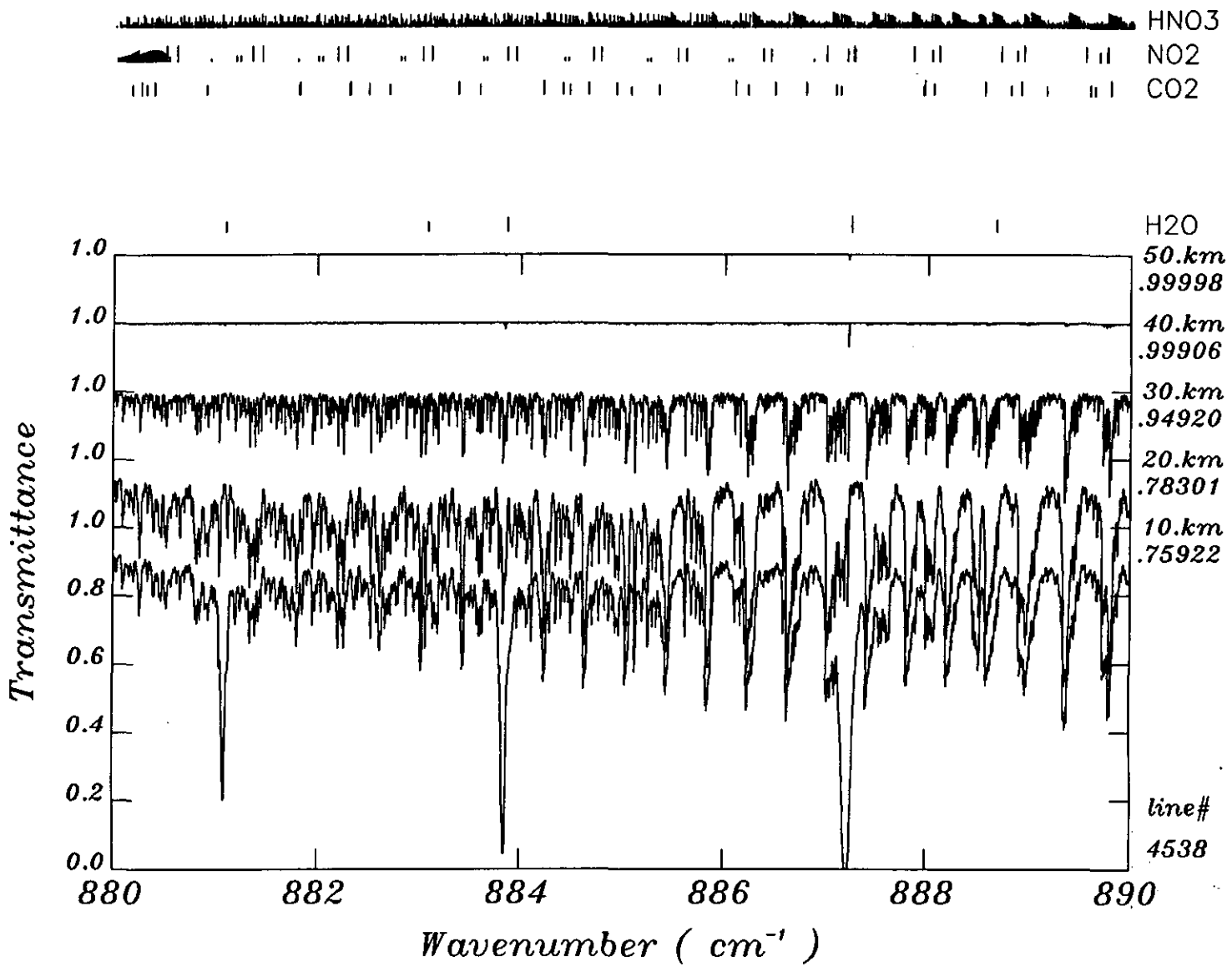

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
.98
1.0
.98
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
0.0
CFC12 (×25)
0.9984
CFC11 (×25)
1.0000
HN03
0.8753
N02
0.9998
C02
1.0000
CH4
1.0000
N20
1.0000
03
1.0000
H20
1.0000
860
862
864
866
868
870
Wavenumber (cm⁻¹)

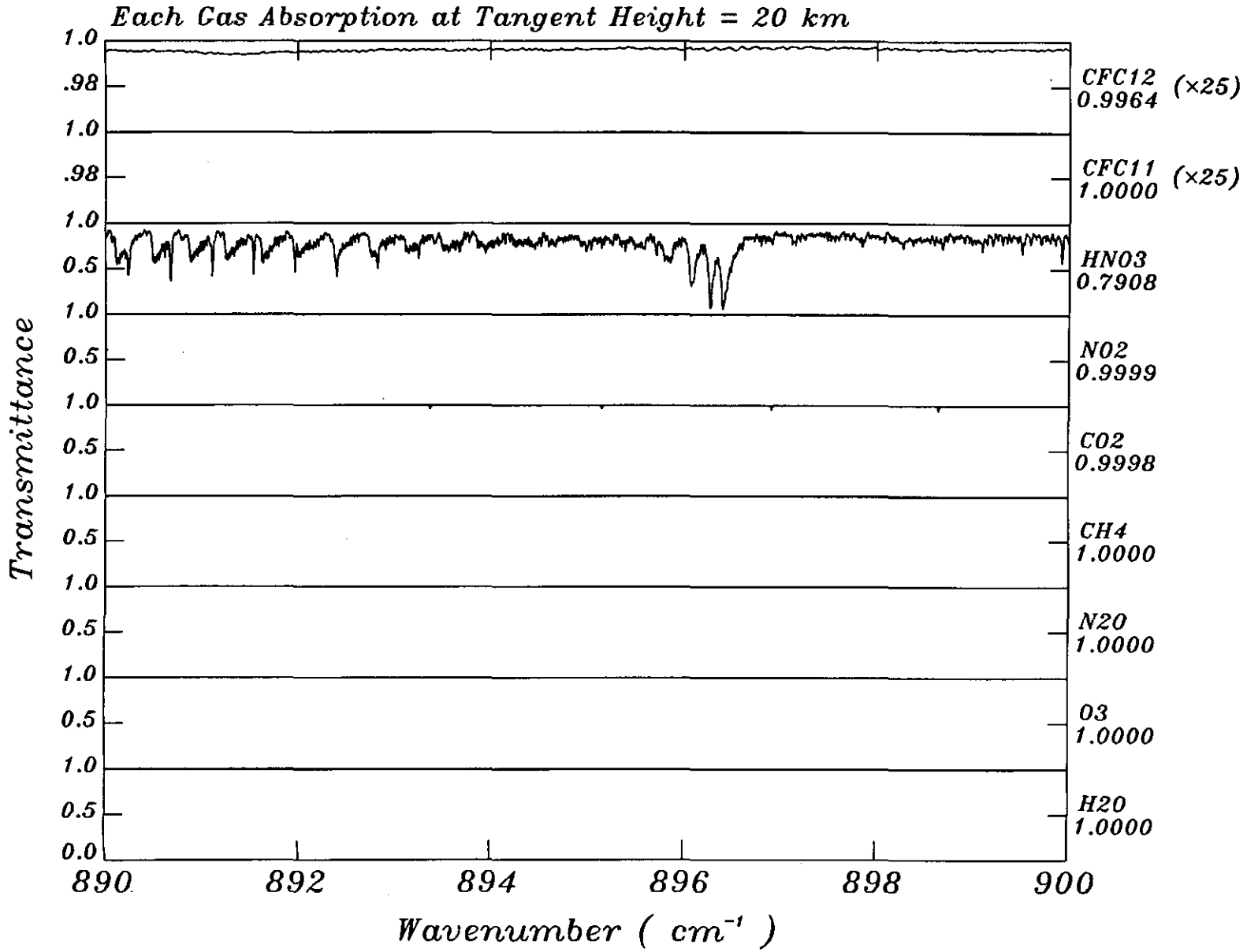

HNO3
NO2
CO2
O3
H2O
50.km
.99999
40.km
.99940
30.km
.97115
20.km
.87370
10.km
.87367
line#
3582
Transmittance
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
860
862
864
866
868
870
Wavenumber (cm⁻¹)

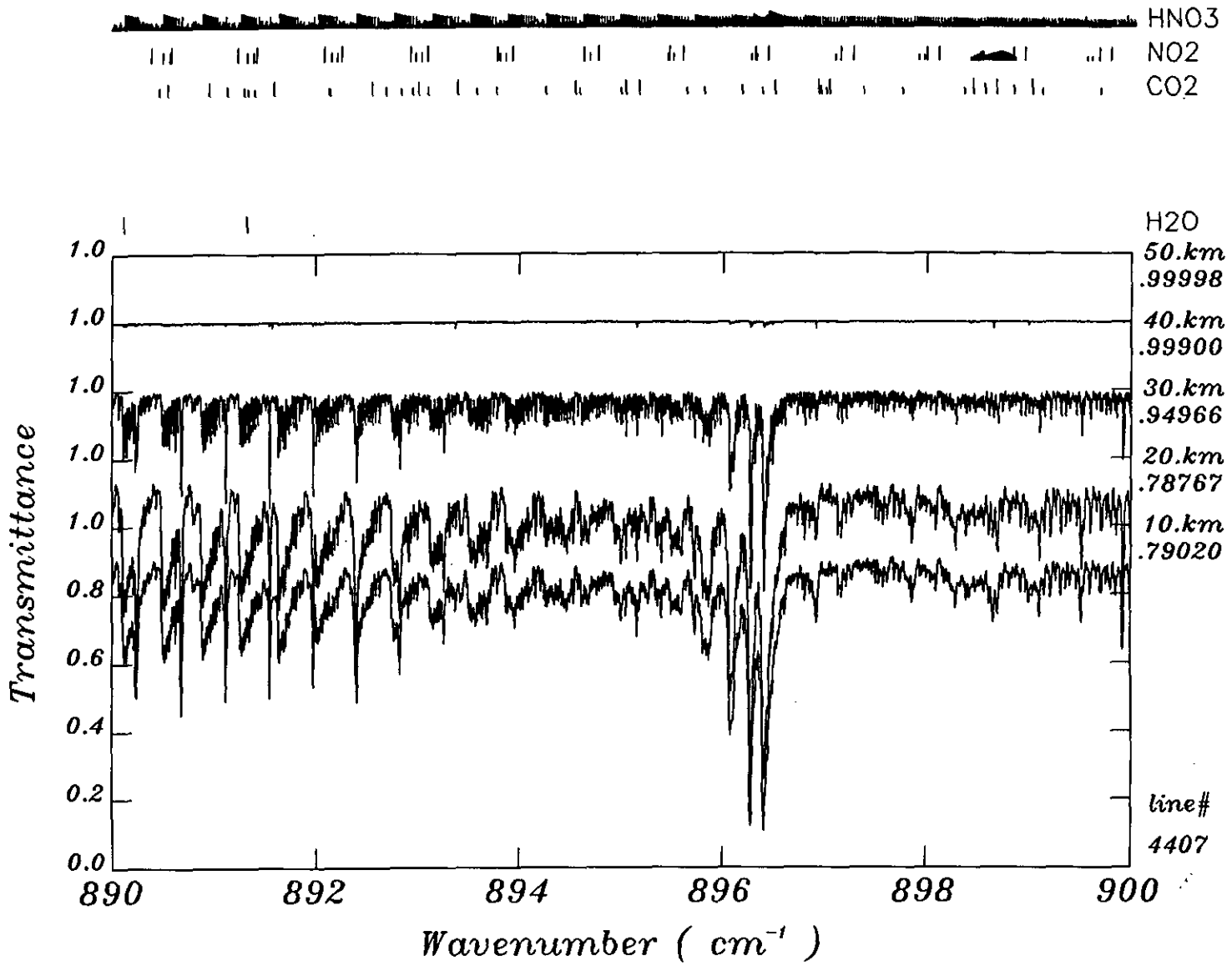

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
.98
1.0
.98
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
0.0
CFC12 (×25)
0.9963
CFC11 (×25)
1.0000
HN03
0.8270
N02
0.9999
C02
1.0000
CH4
1.0000
N20
1.0000
03
1.0000
H20
0.9998
870
872
874
876
878
880
Wavenumber (cm⁻¹)

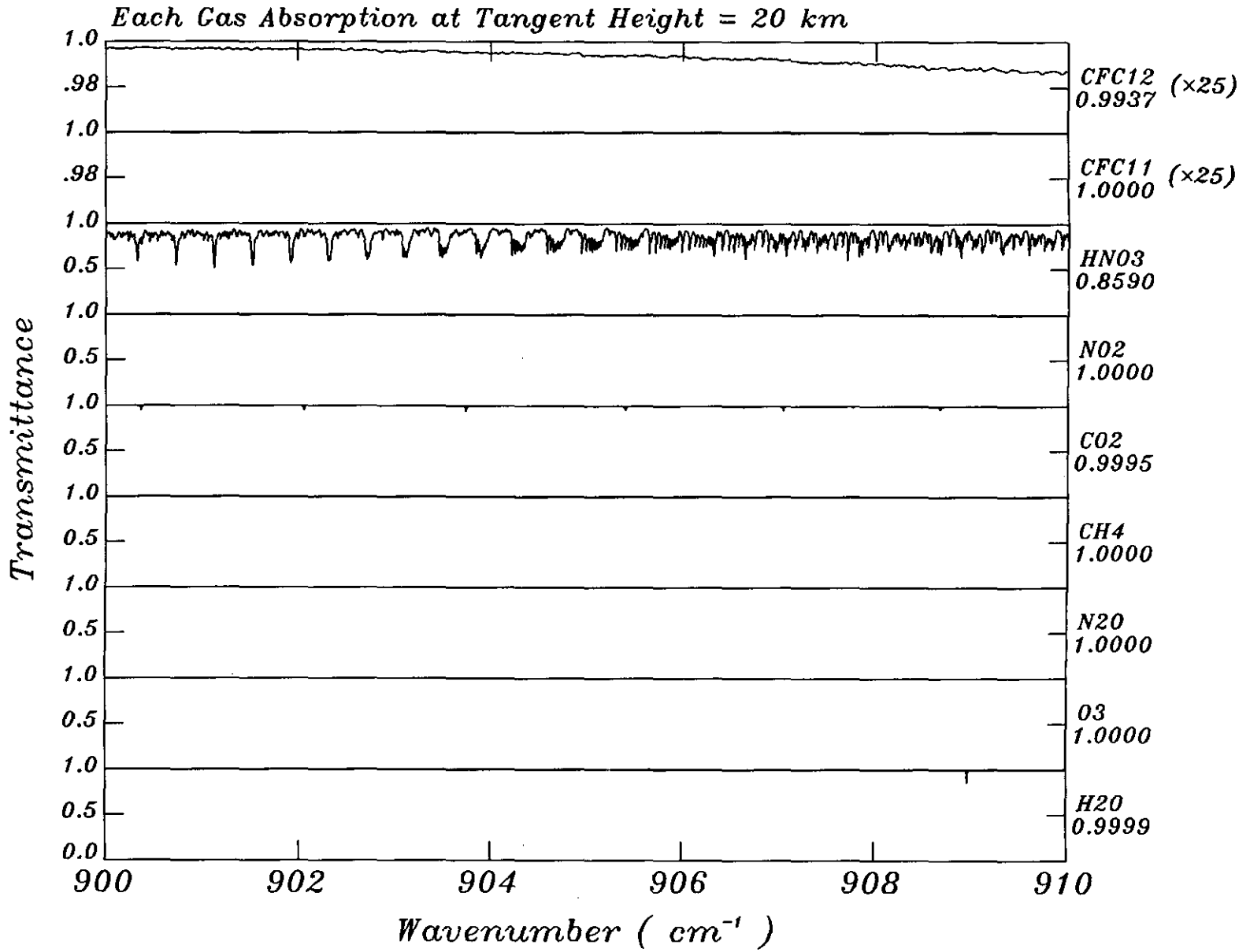

HNO3
NO2
CO2
O3
H2O
50.km
.99999
40.km
.99918
30.km
.95790
20.km
.82378
10.km
.80853
line#
4261
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
Transmittance
870
872
874
876
878
880
Wavenumber (cm⁻¹)

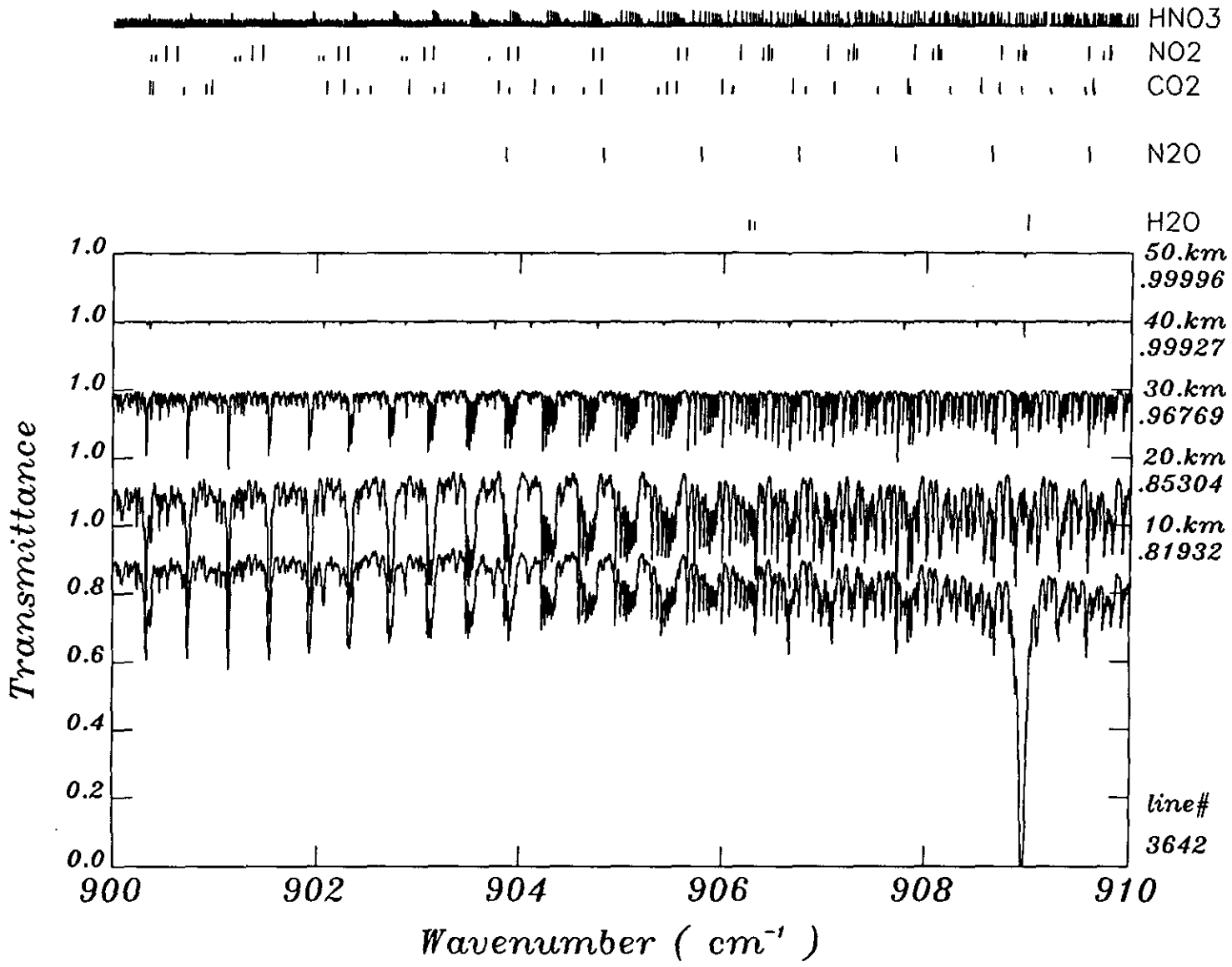

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
.98
1.0
.98
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
0.0
CFC12 (×25)
0.9950
CFC11 (×25)
1.0000
HNO3
0.7873
NO2
0.9999
CO2
1.0000
CH4
1.0000
N2O
1.0000
O3
1.0000
H2O
0.9997
880
882
884
886
888
890
Wavenumber (cm⁻¹)

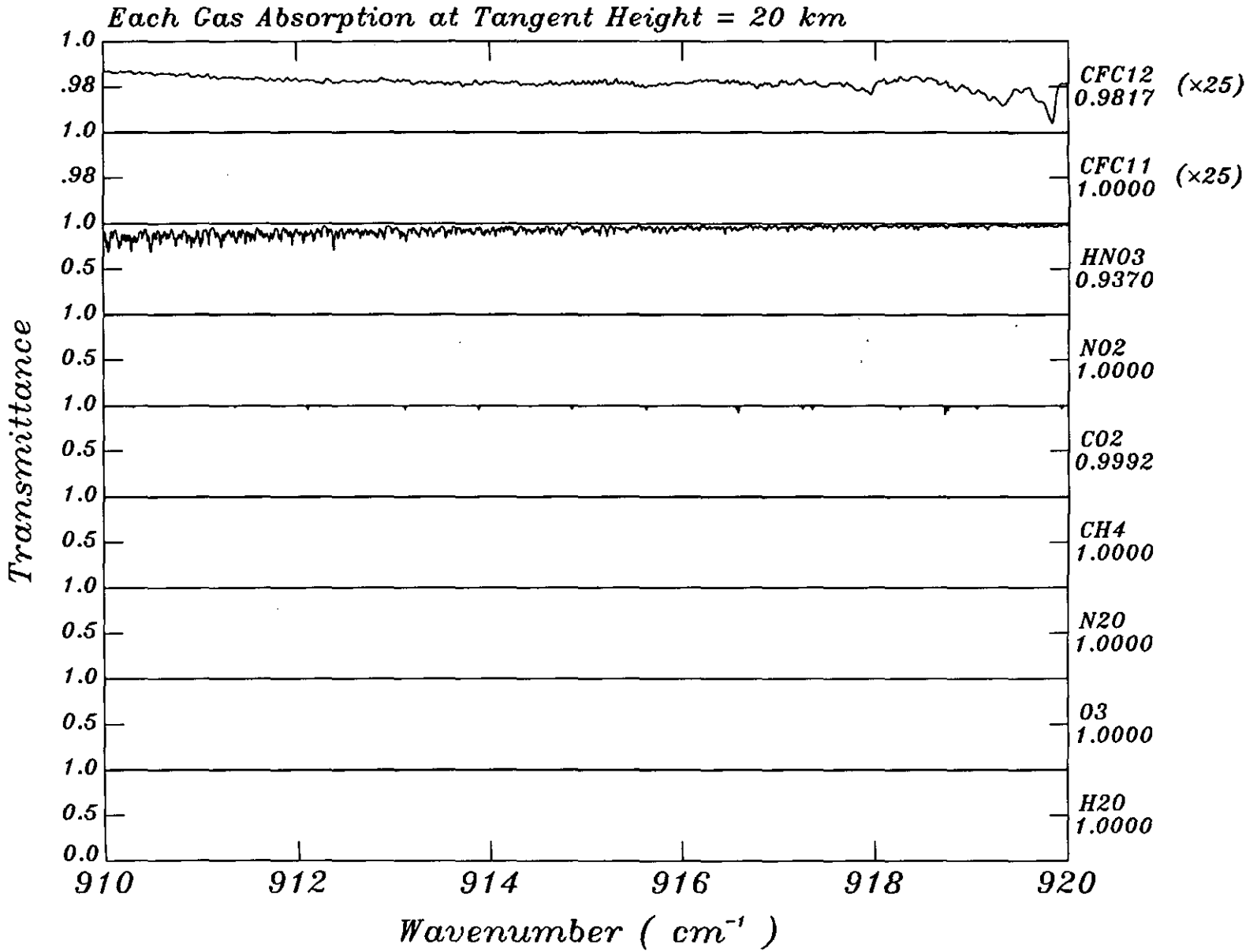

HNO3
NO2
CO2
H2O
50.km
.99998
40.km
.99906
30.km
.94920
20.km
.78301
10.km
.75922
line#
4538
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
Transmittance
880
882
884
886
888
890
Wavenumber (cm⁻¹)

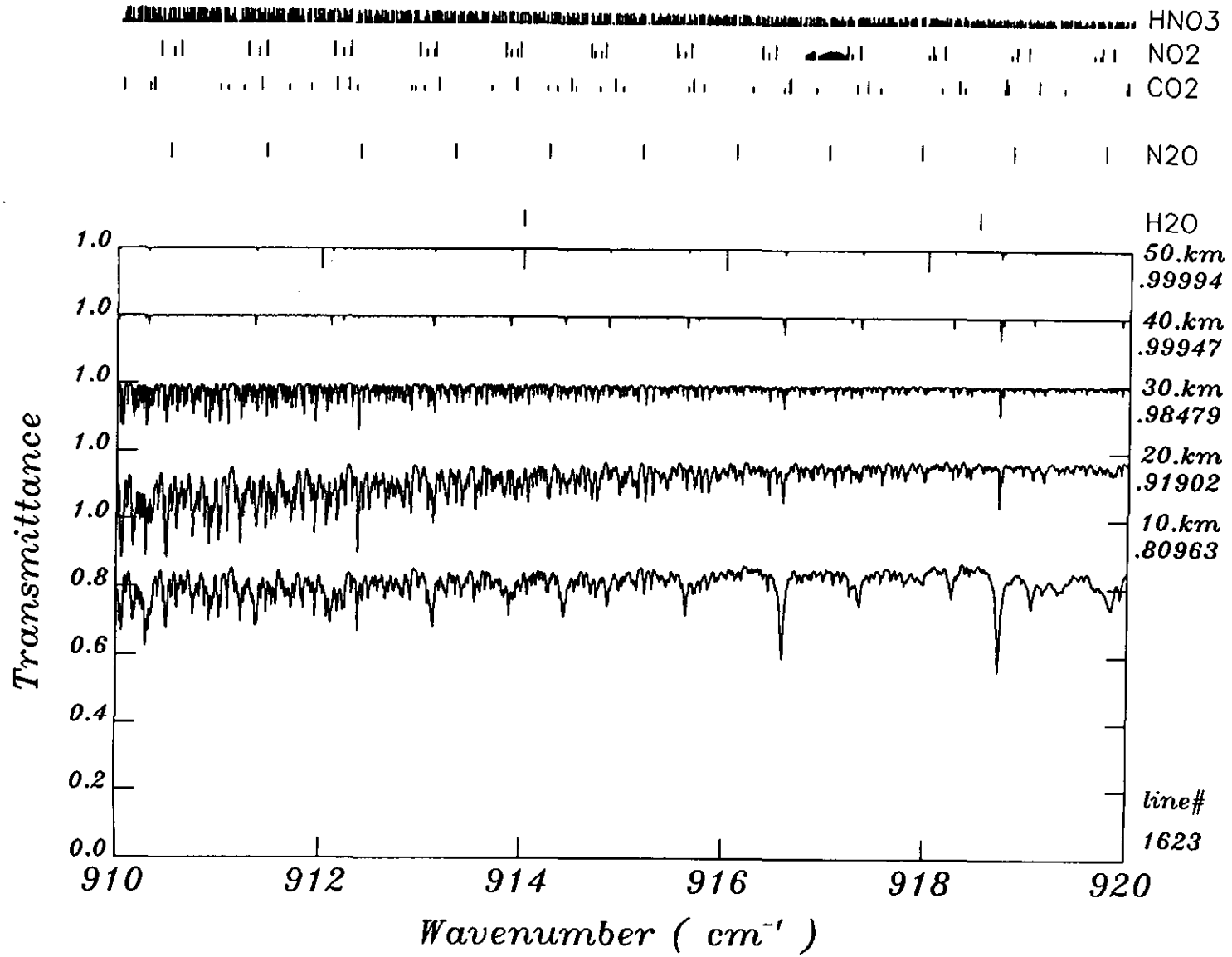

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
.98
1.0
.98
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
0.0
CFC12 (×25)
0.9964
CFC11 (×25)
1.0000
HN03
0.7908
N02
0.9999
C02
0.9998
CH4
1.0000
N20
1.0000
03
1.0000
H20
1.0000
890
892
894
896
898
900
Wavenumber (cm⁻¹)

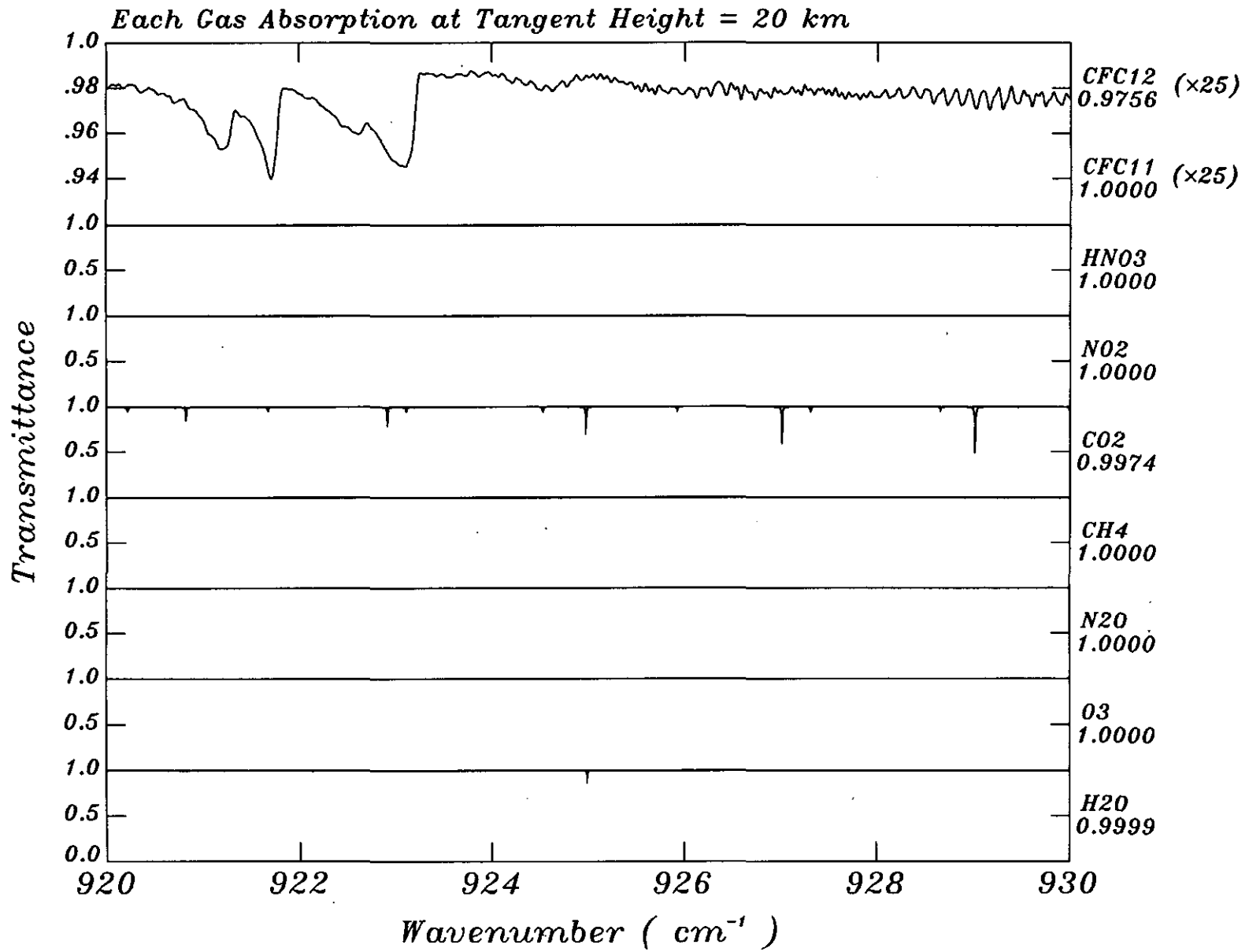

HNO3
NO2
CO2
H2O
50.km
.99998
40.km
.99900
30.km
.94966
20.km
.78767
10.km
.79020
line#
4407
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
Transmittance
890
892
894
896
898
900
Wavenumber (cm⁻¹)

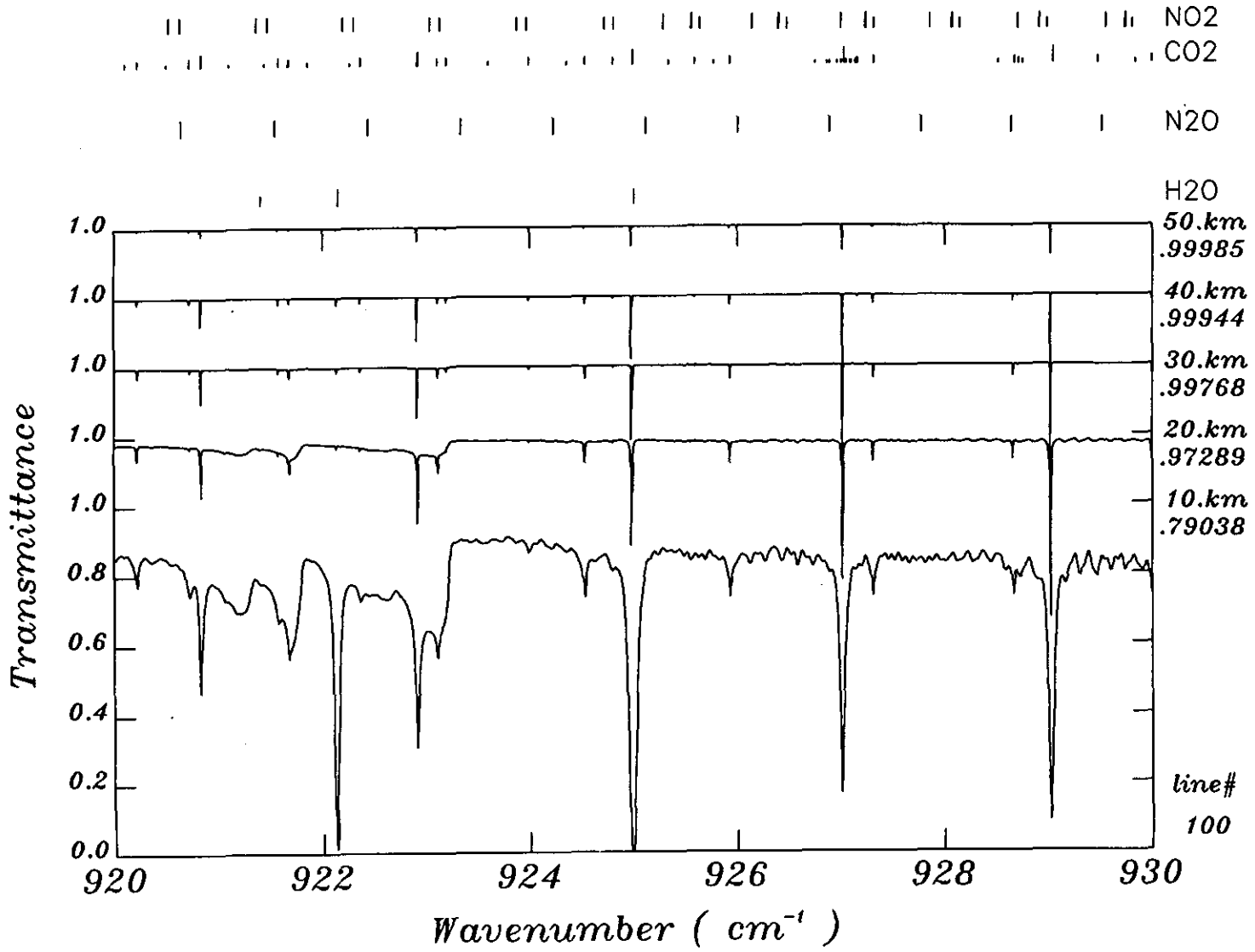

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
.98
1.0
.98
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
0.0
CFC12 (×25)
0.9937
CFC11 (×25)
1.0000
HN03
0.8590
N02
1.0000
C02
0.9995
CH4
1.0000
N20
1.0000
03
1.0000
H20
0.9999
900
902
904
906
908
910
Wavenumber (cm⁻¹)

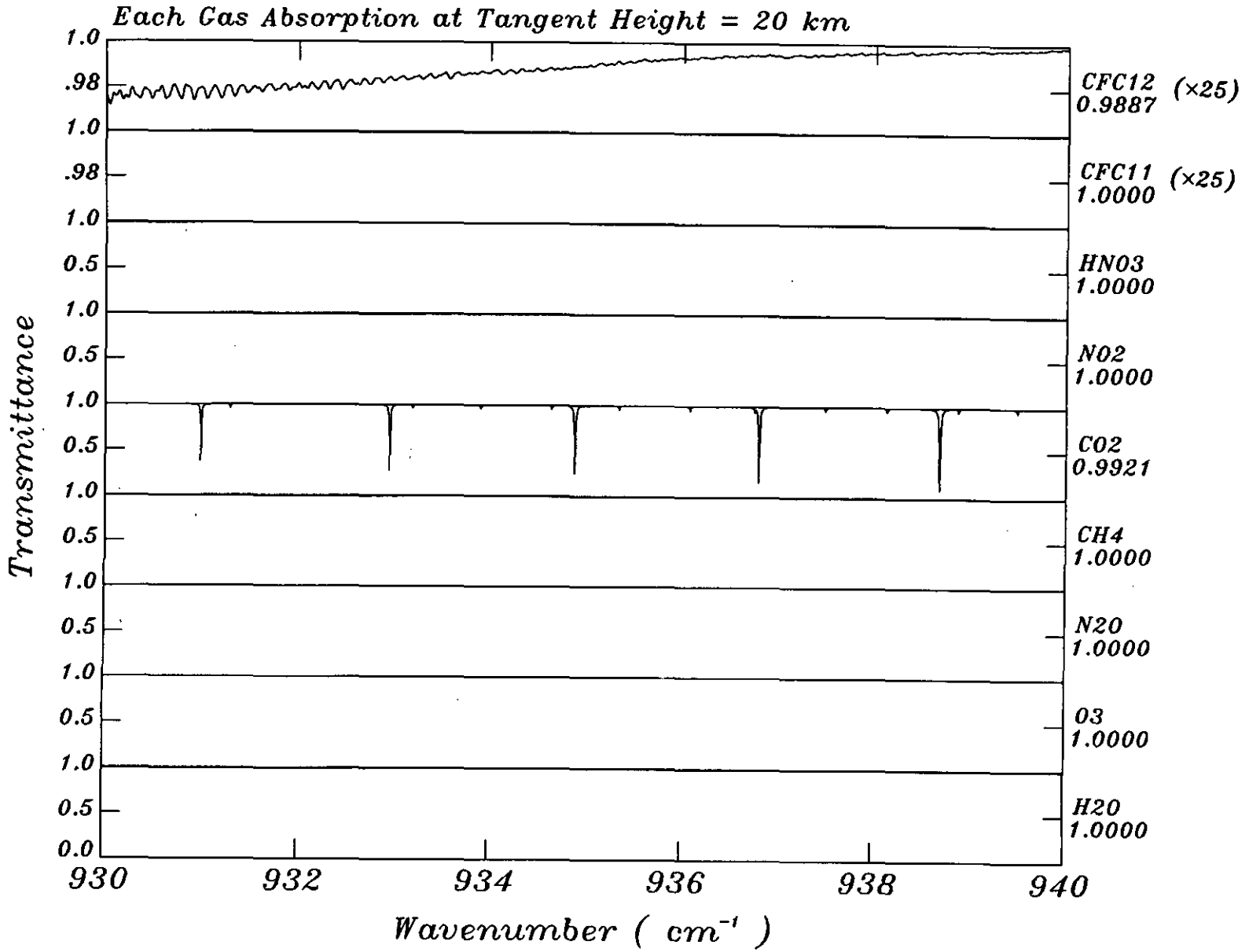

HNO3
NO2
CO2
N2O
H2O
50.km
.99996
40.km
.99927
30.km
.96769
20.km
.85304
10.km
.81932
line#
3642
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
Transmittance
900
902
904
906
908
910
Wavenumber (cm⁻¹)

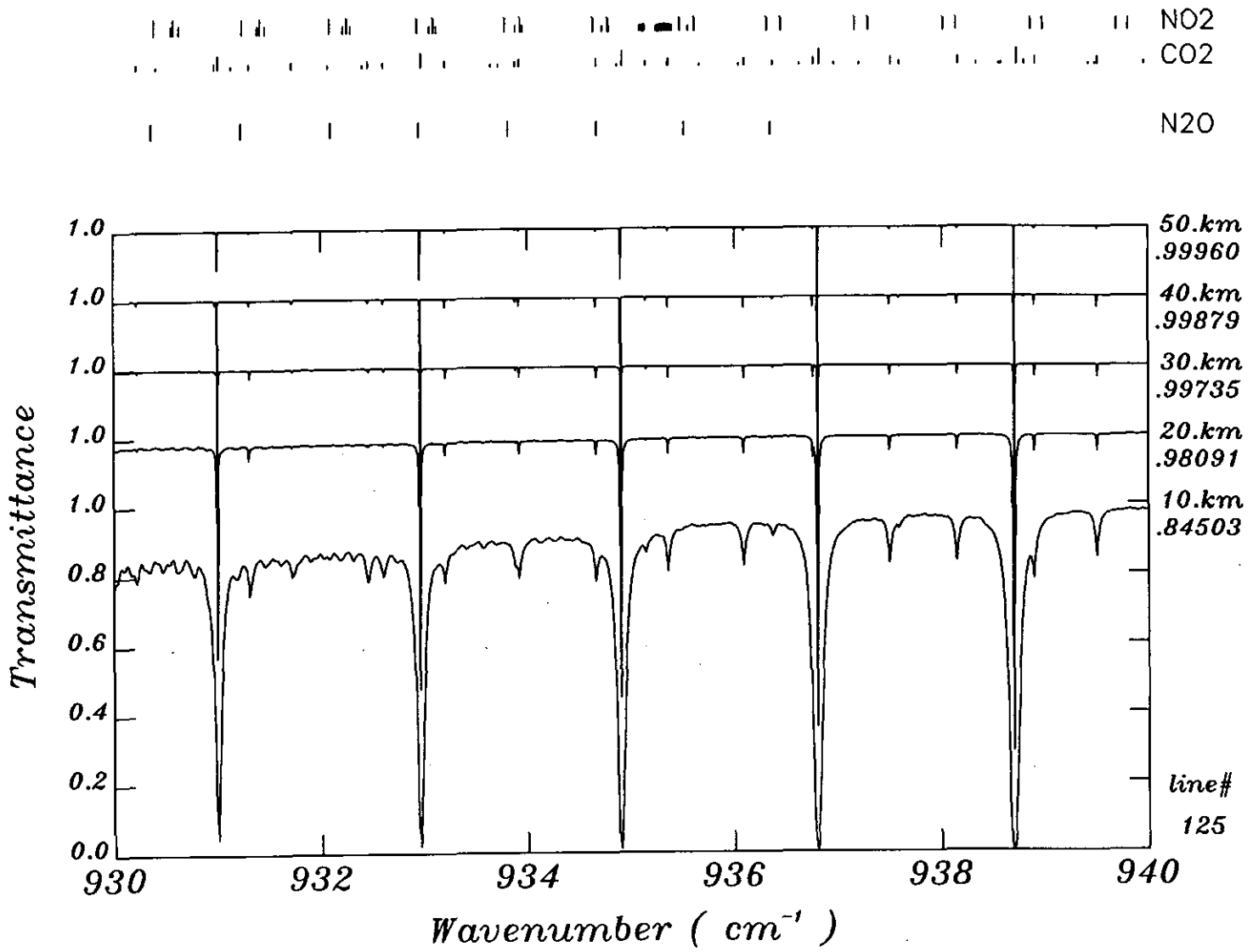

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
.98
1.0
.98
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
0.0
CFC12
0.9817
(×25)
CFC11
1.0000
(×25)
HN03
0.9370
N02
1.0000
C02
0.9992
CH4
1.0000
N20
1.0000
03
1.0000
H20
1.0000
910
912
914
916
918
920
Wavenumber (cm⁻¹)

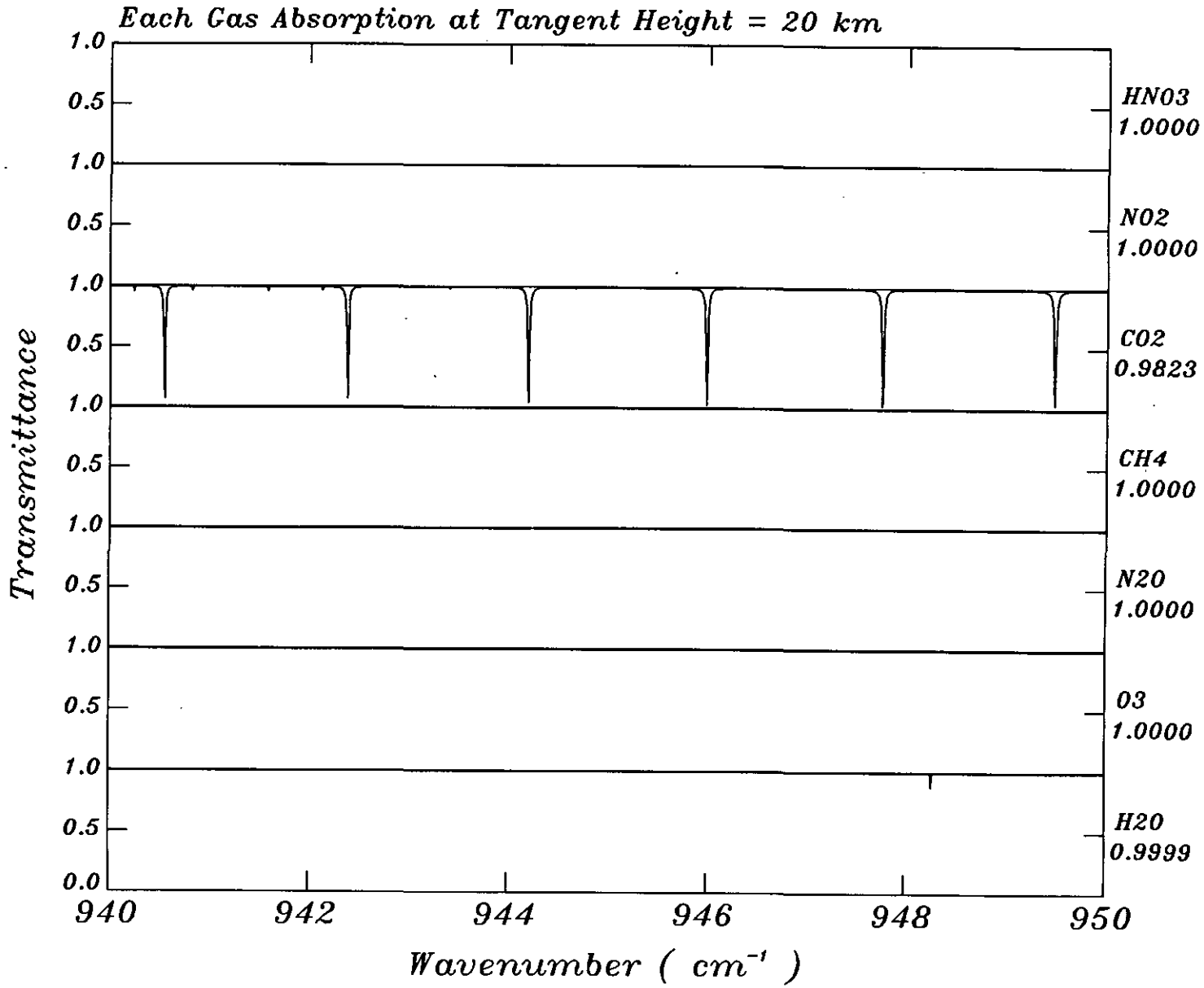

HNO3
NO2
CO2
N2O
H2O
50.km
.99994
40.km
.99947
30.km
.98479
20.km
.91902
10.km
.80963
line#
1623
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
Transmittance
910
912
914
916
918
920
Wavenumber (cm⁻¹)

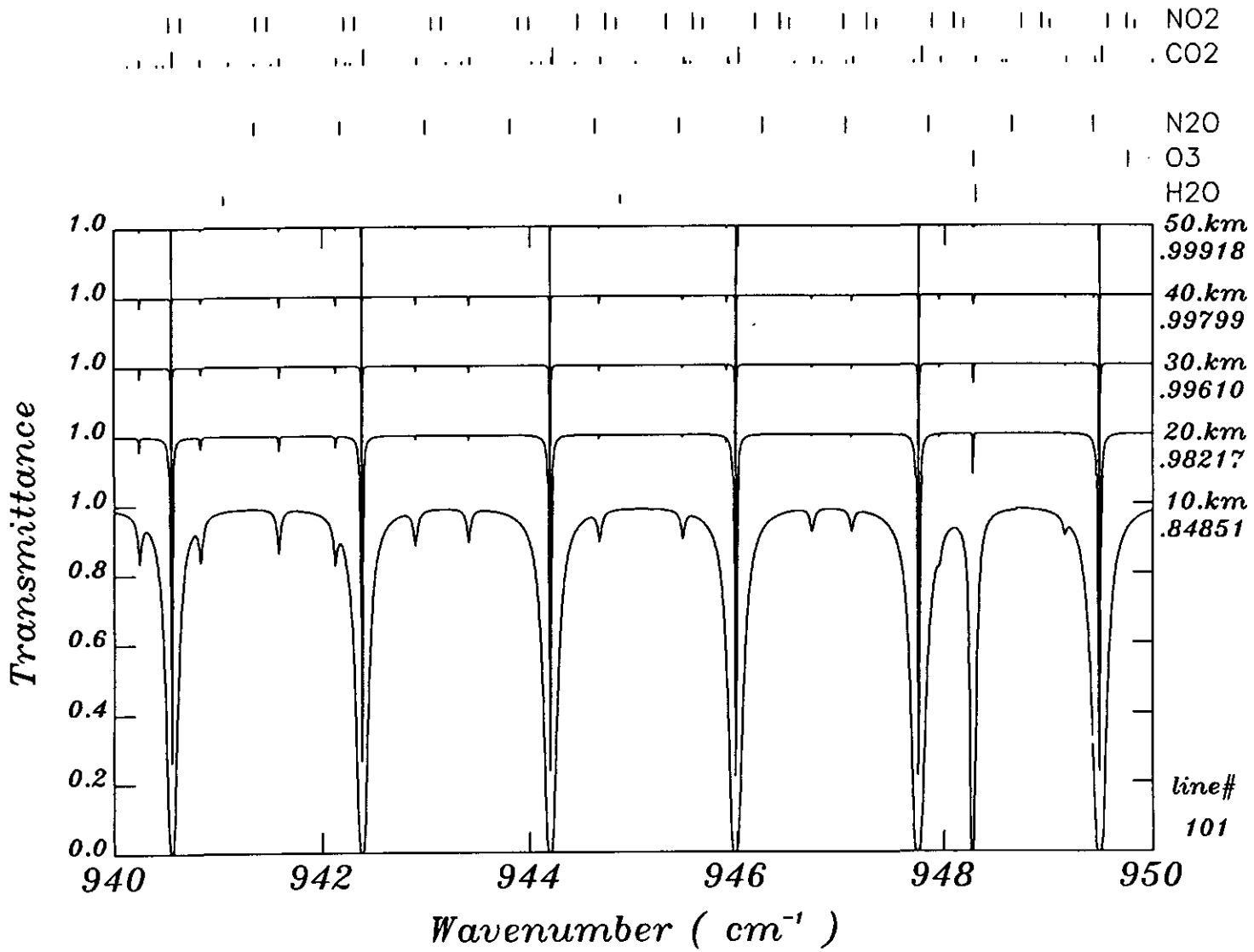

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
.98
.96
.94
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
0.0
CFC12 (×25)
0.9756
CFC11 (×25)
1.0000
HN03
1.0000
N02
1.0000
C02
0.9974
CH4
1.0000
N20
1.0000
03
1.0000
H20
0.9999
920
922
924
926
928
930
Wavenumber (cm⁻¹)

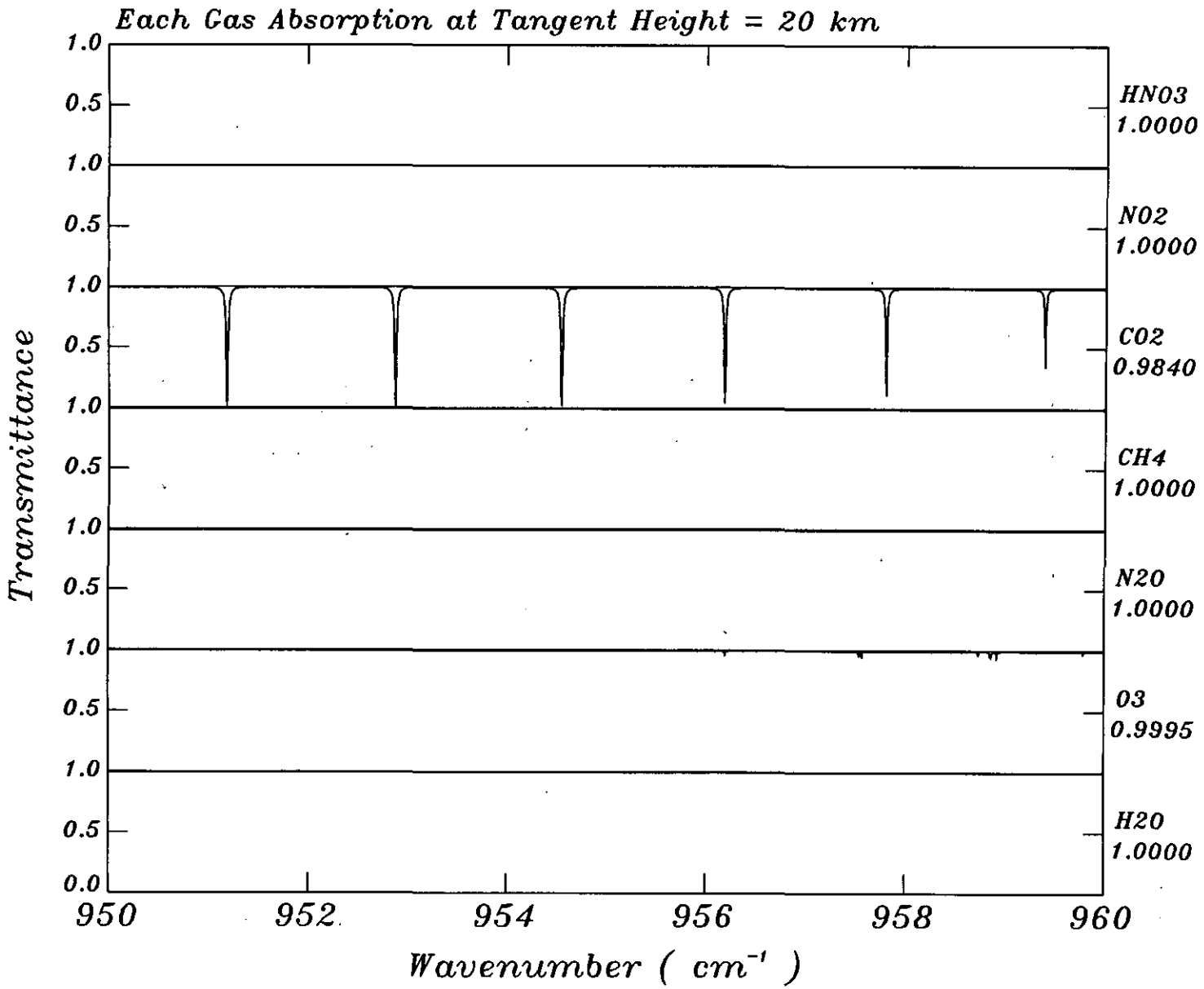

NO2
CO2
N2O
H2O
50.km
.99985
40.km
.99944
30.km
.99768
20.km
.97289
10.km
.79038
line#
100
1.0
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
Transmittance
920
922
924
926
928
930
Wavenumber (cm⁻¹)

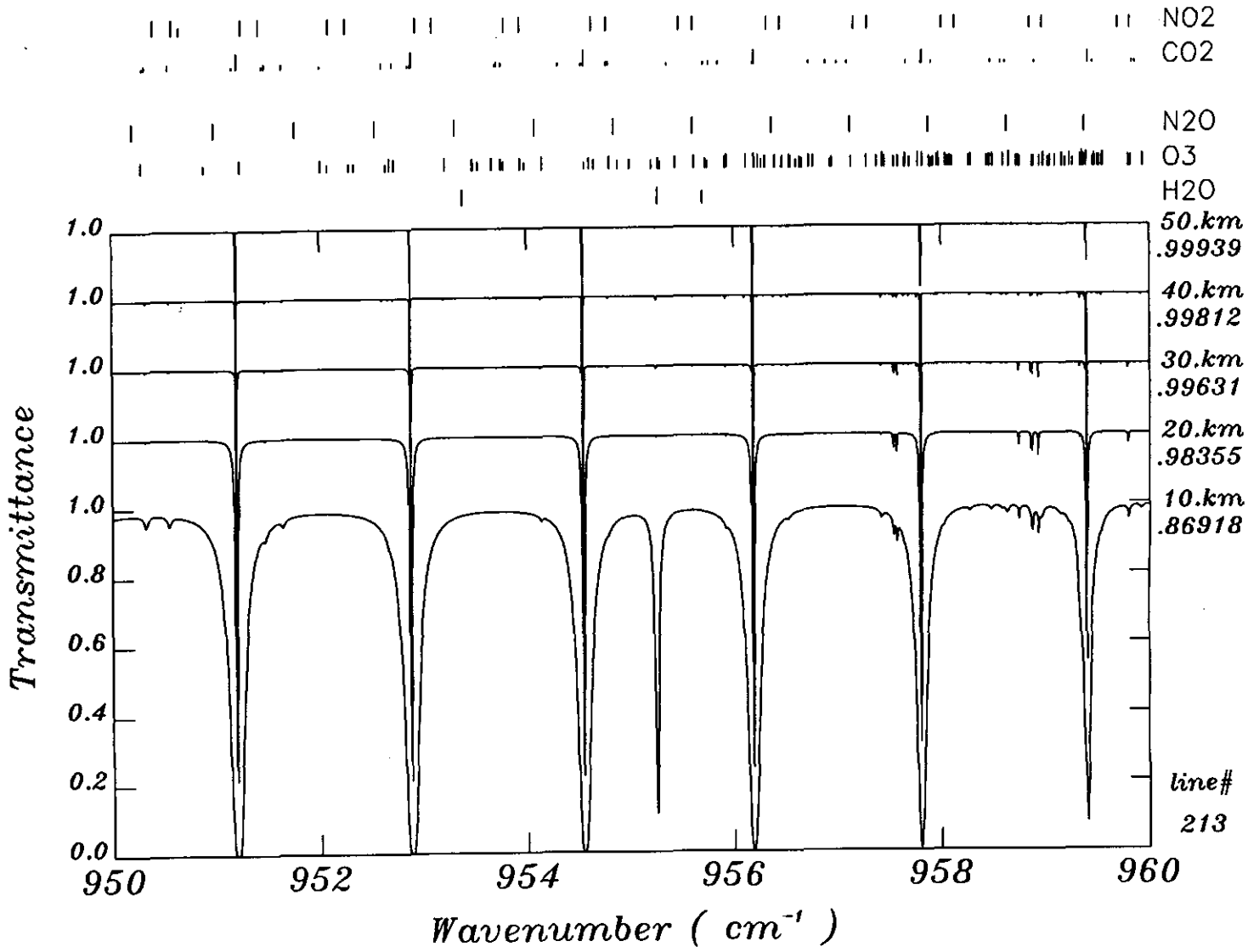

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
.98
1.0
.98
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
0.0
CFC12 (×25)
0.9887
CFC11 (×25)
1.0000
HN03
1.0000
N02
1.0000
C02
0.9921
CH4
1.0000
N20
1.0000
03
1.0000
H20
1.0000
930
932
934
936
938
940
Wavenumber (cm⁻¹)

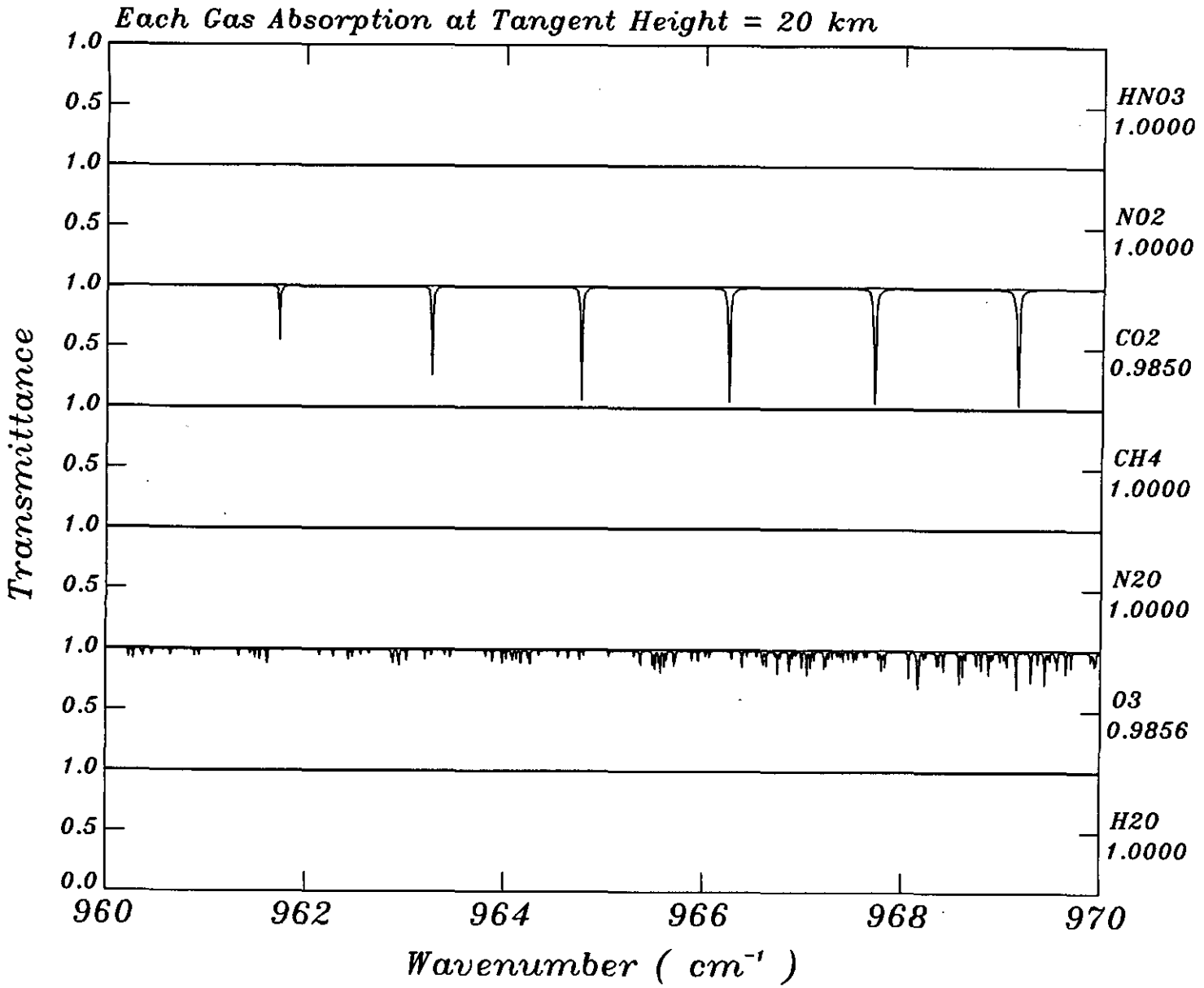

NO2
CO2
N2O
1.0
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
Transmittance
50.km
.99960
40.km
.99879
30.km
.99735
20.km
.98091
10.km
.84503
line#
125
930
932
934
936
938
940
Wavenumber (cm⁻¹)

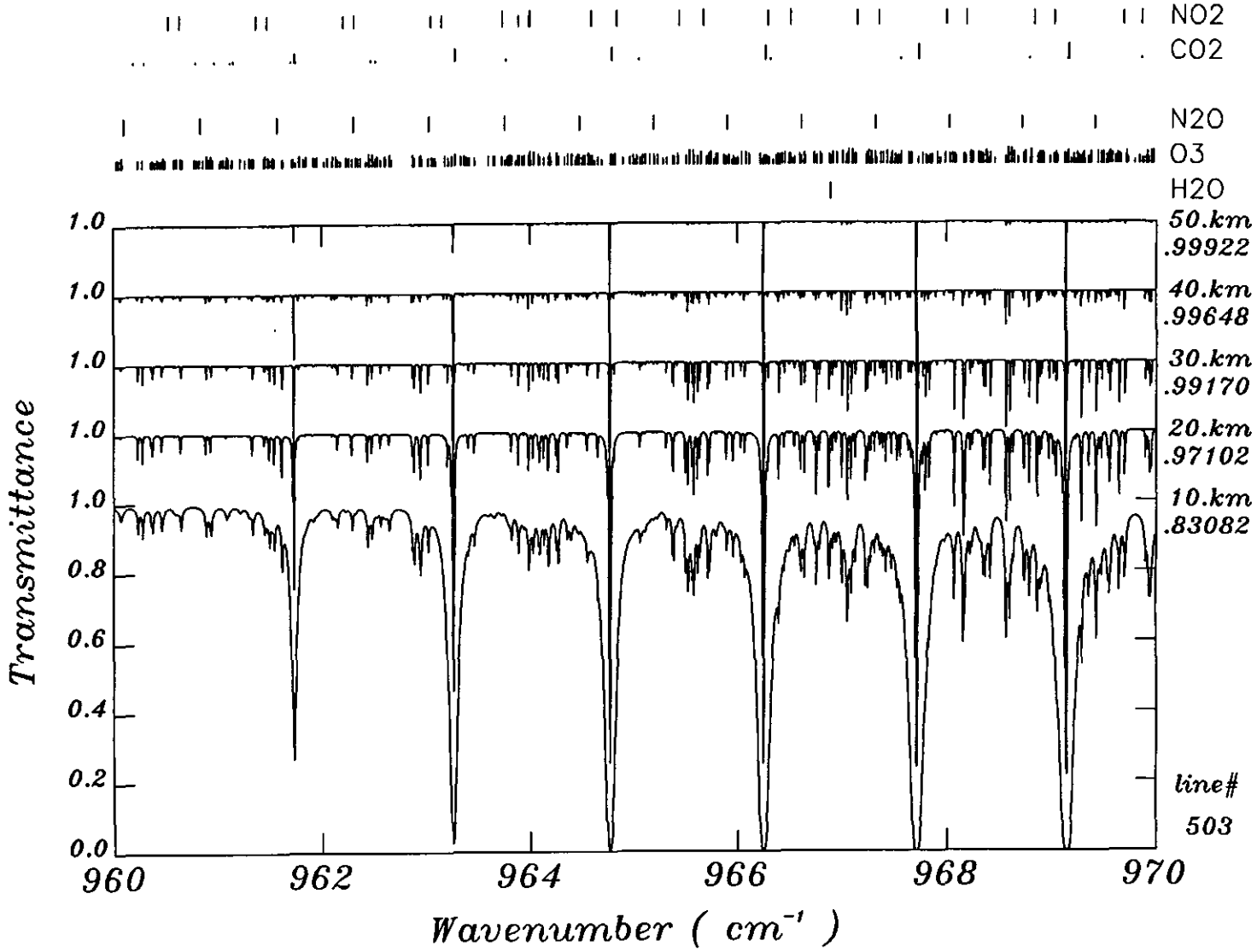

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
0.0
HN03
1.0000
NO2
1.0000
CO2
0.9823
CH4
1.0000
N20
1.0000
03
1.0000
H20
0.9999
940
942
944
946
948
950
Wavenumber (cm⁻¹)

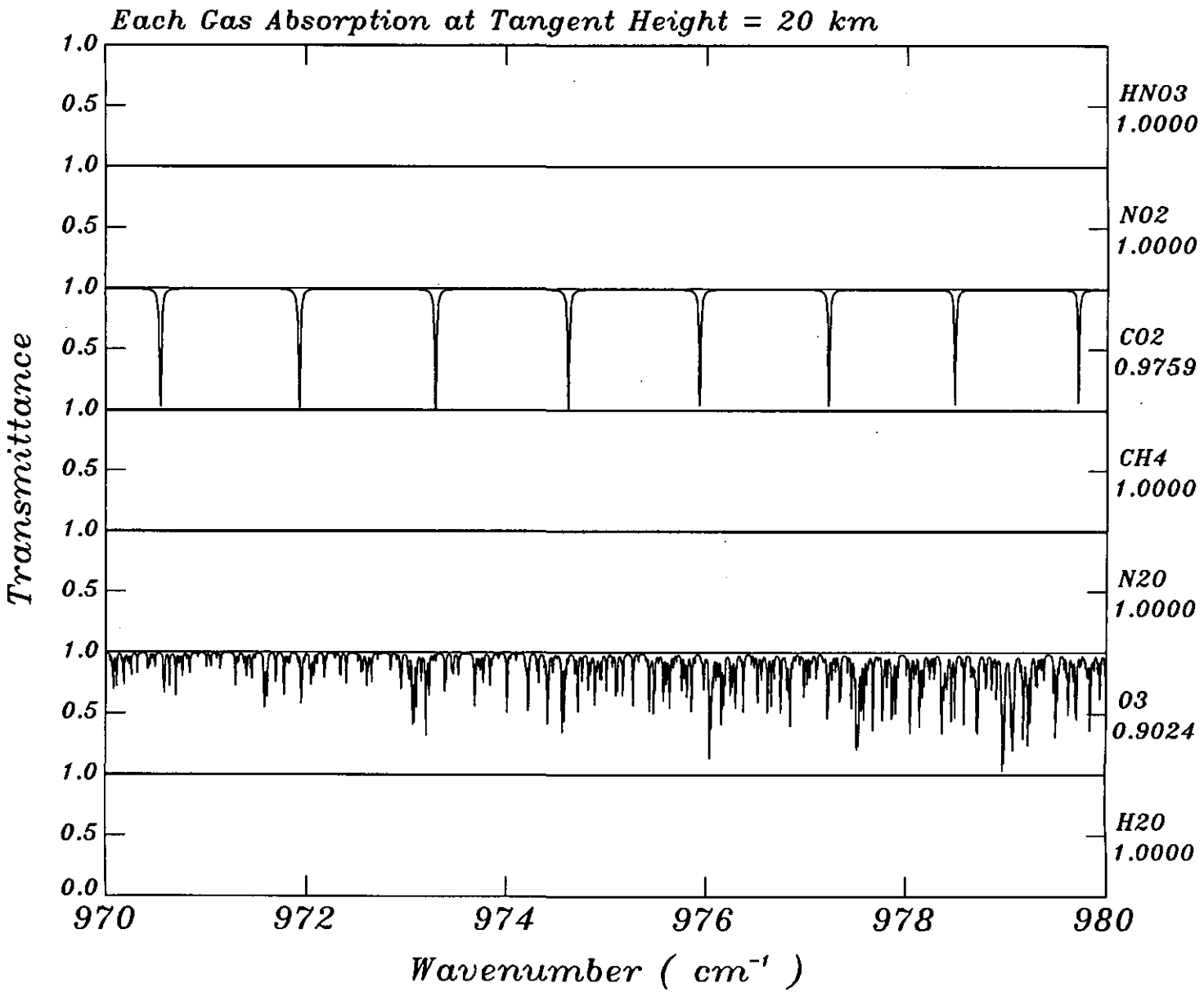

NO2
CO2
N2O
O3
H2O
50.km
.99918
40.km
.99799
30.km
.99610
20.km
.98217
10.km
.84851
line#
101
1.0
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
Transmittance
940
942
944
946
948
950
Wavenumber (cm⁻¹)

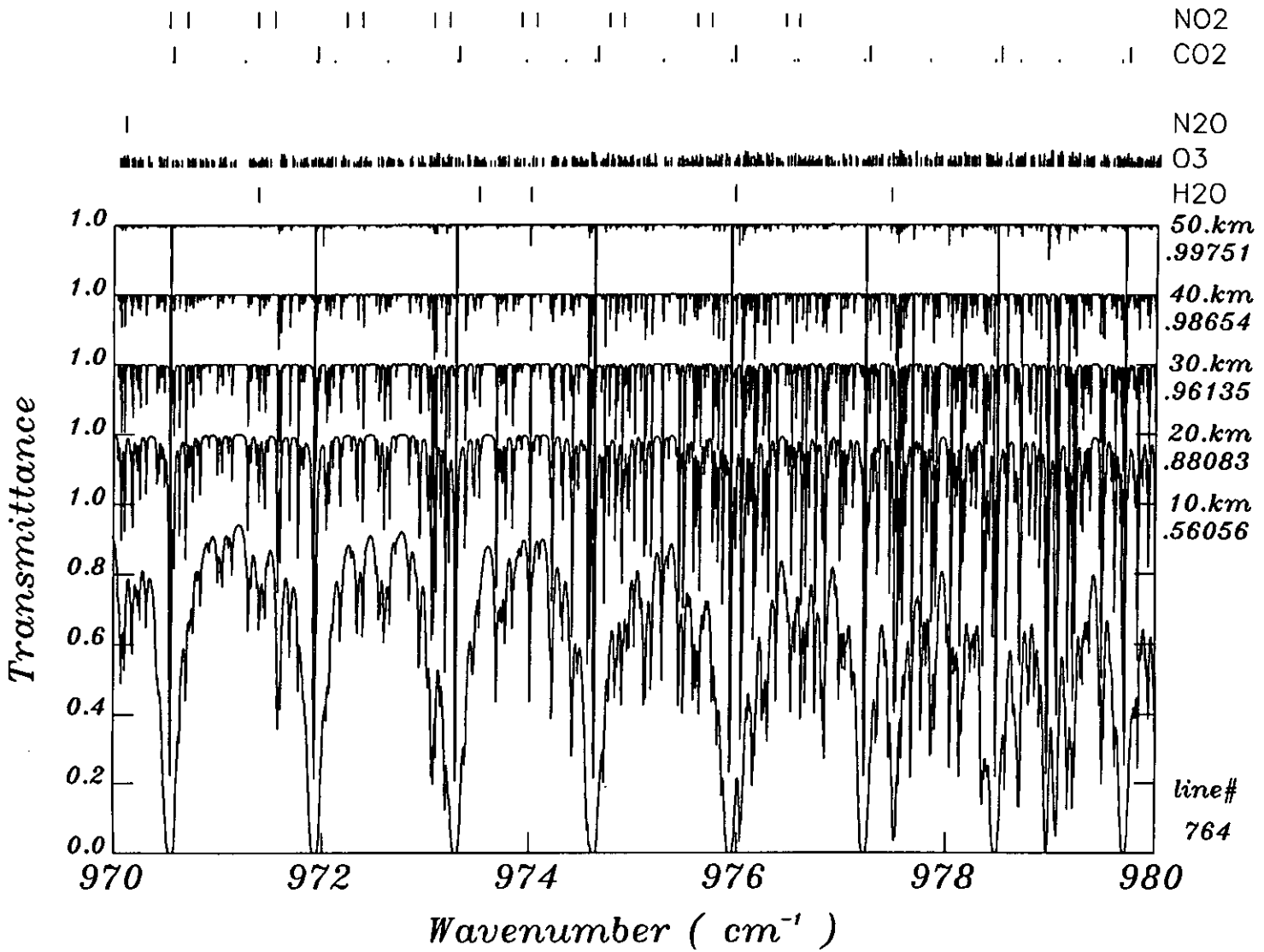

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
0.5
0.0
HNO3
1.0000
NO2
1.0000
CO2
0.9840
CH4
1.0000
N2O
1.0000
O3
0.9995
H2O
1.0000
950
952
954
956
958
960
Wavenumber (cm⁻¹)

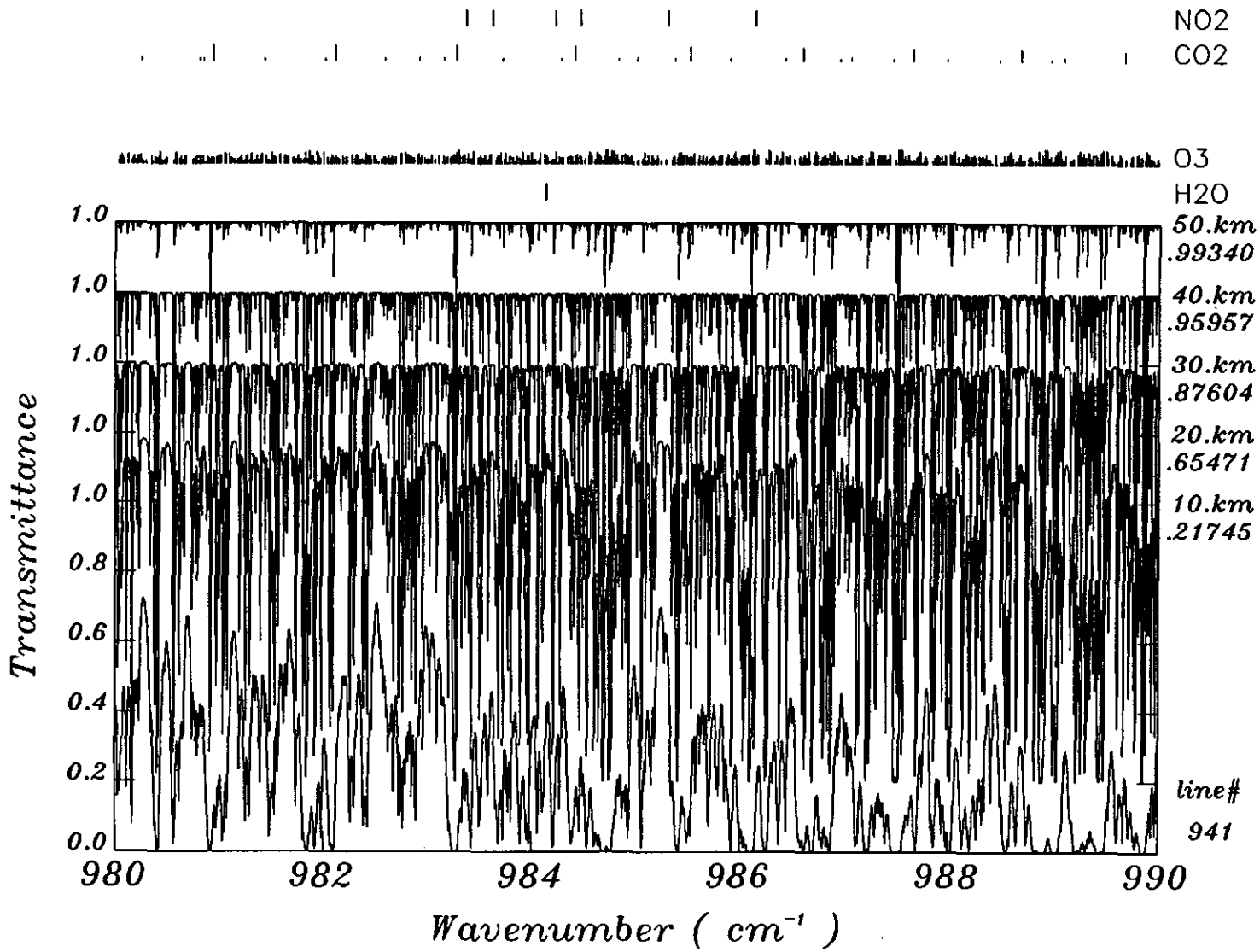

NO2
CO2
N2O
O3
H2O
50.km
.99939
40.km
.99812
30.km
.99631
20.km
.98355
10.km
.86918
line#
213
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
Transmittance
950
952
954
956
958
960
Wavenumber (cm⁻¹)

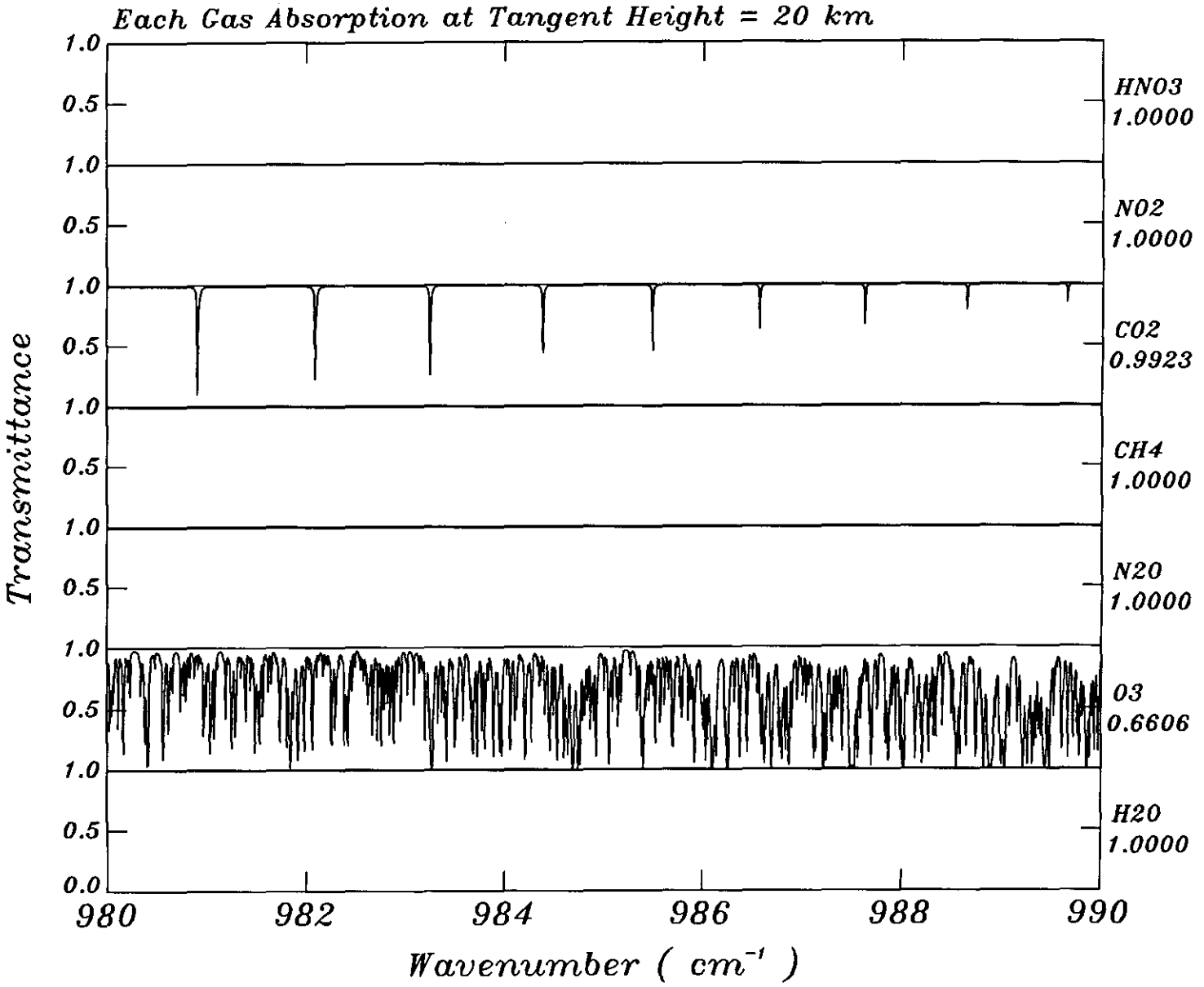

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
0.5
0.0
HNO3
1.0000
NO2
1.0000
CO2
0.9850
CH4
1.0000
N2O
1.0000
O3
0.9856
H2O
1.0000
960
962
964
966
968
970
Wavenumber (cm⁻¹)

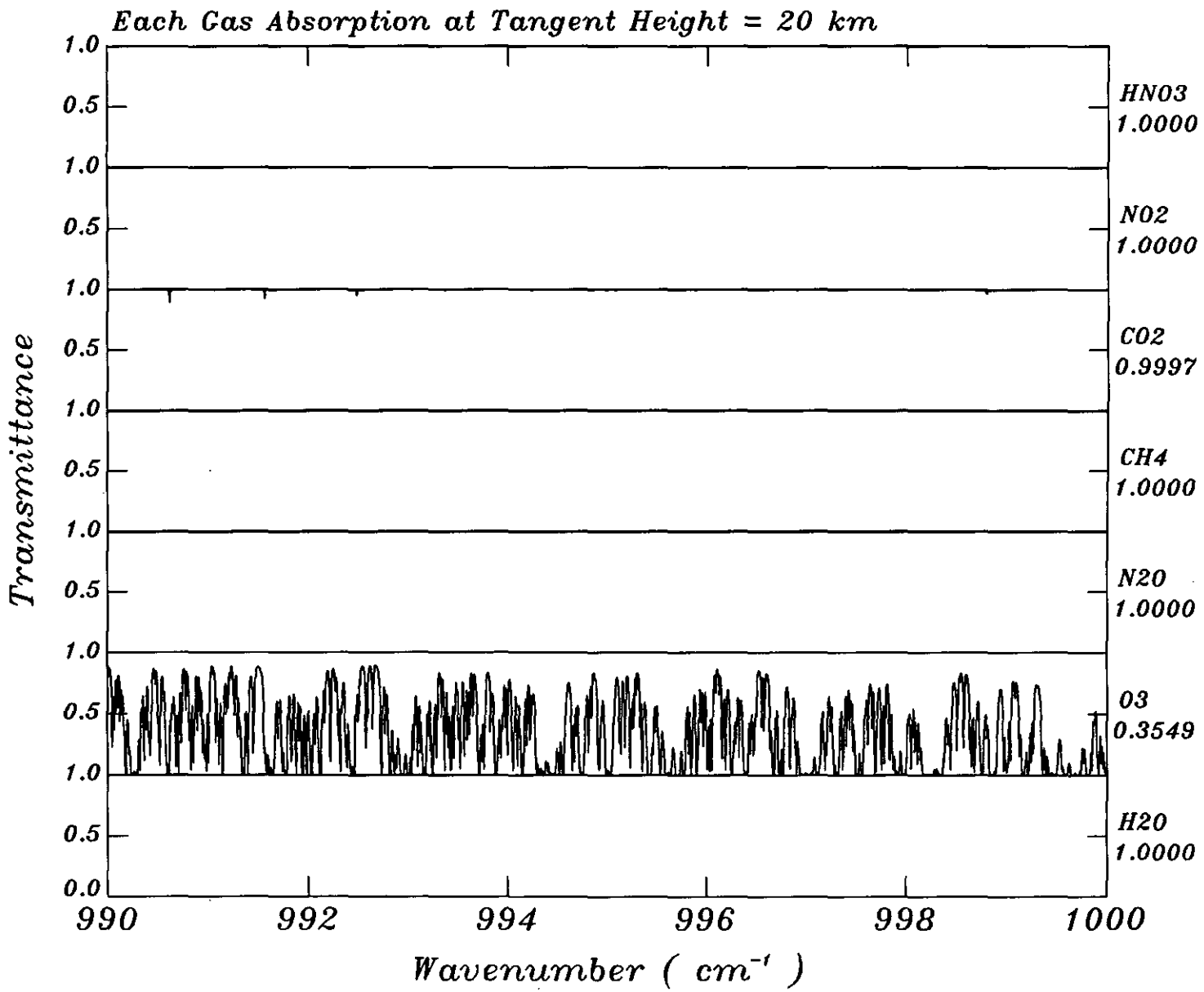

NO2
CO2
N2O
O3
H2O
50.km
.99922
40.km
.99648
30.km
.99170
20.km
.97102
10.km
.83082
line#
503
1.0
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
Transmittance
960
962
964
966
968
970
Wavenumber (cm⁻¹)

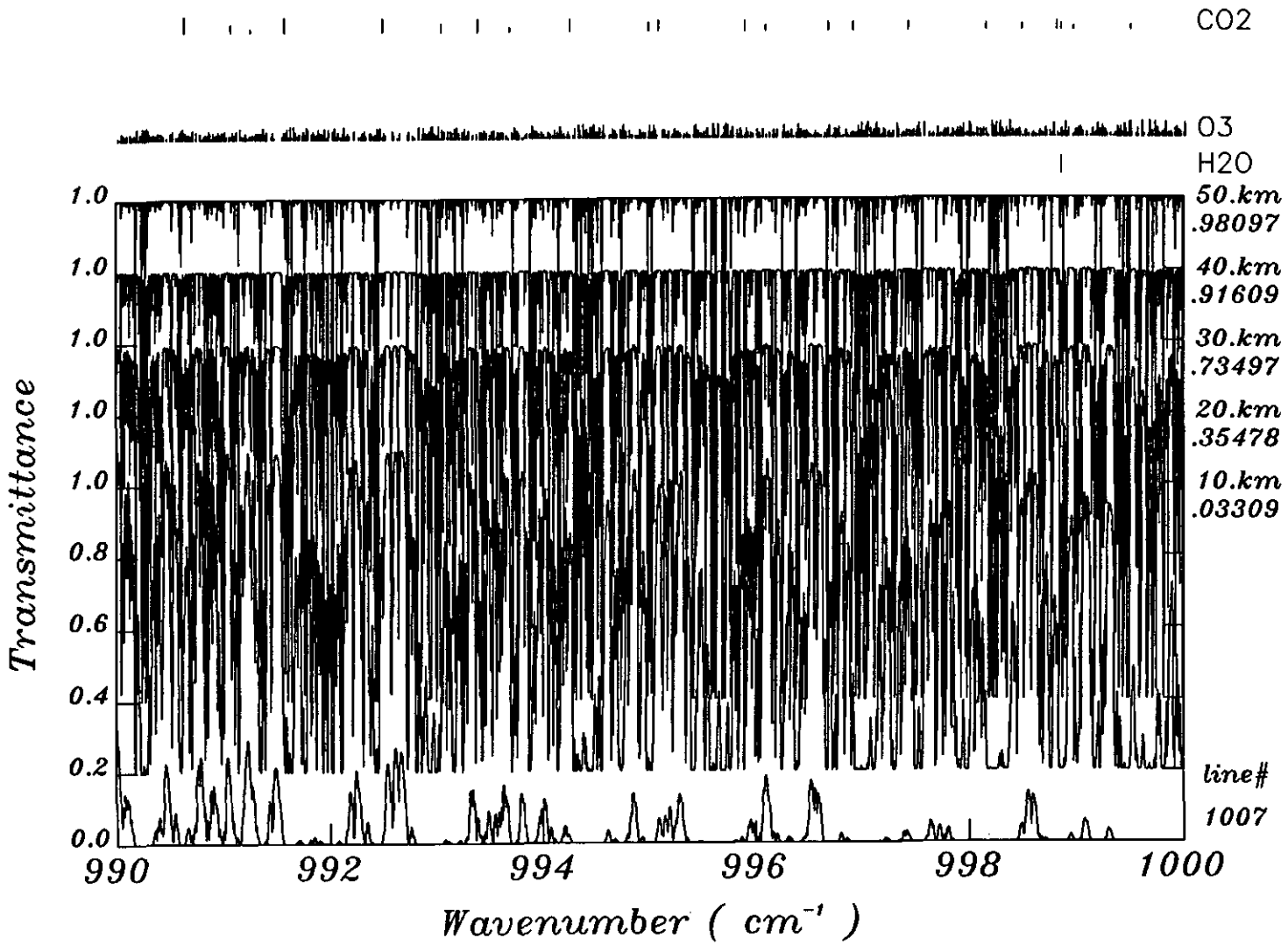

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
0.5
0.0
HN03
1.0000
NO2
1.0000
CO2
0.9759
CH4
1.0000
N20
1.0000
03
0.9024
H20
1.0000
970
972
974
976
978
980
Wavenumber (cm⁻¹)

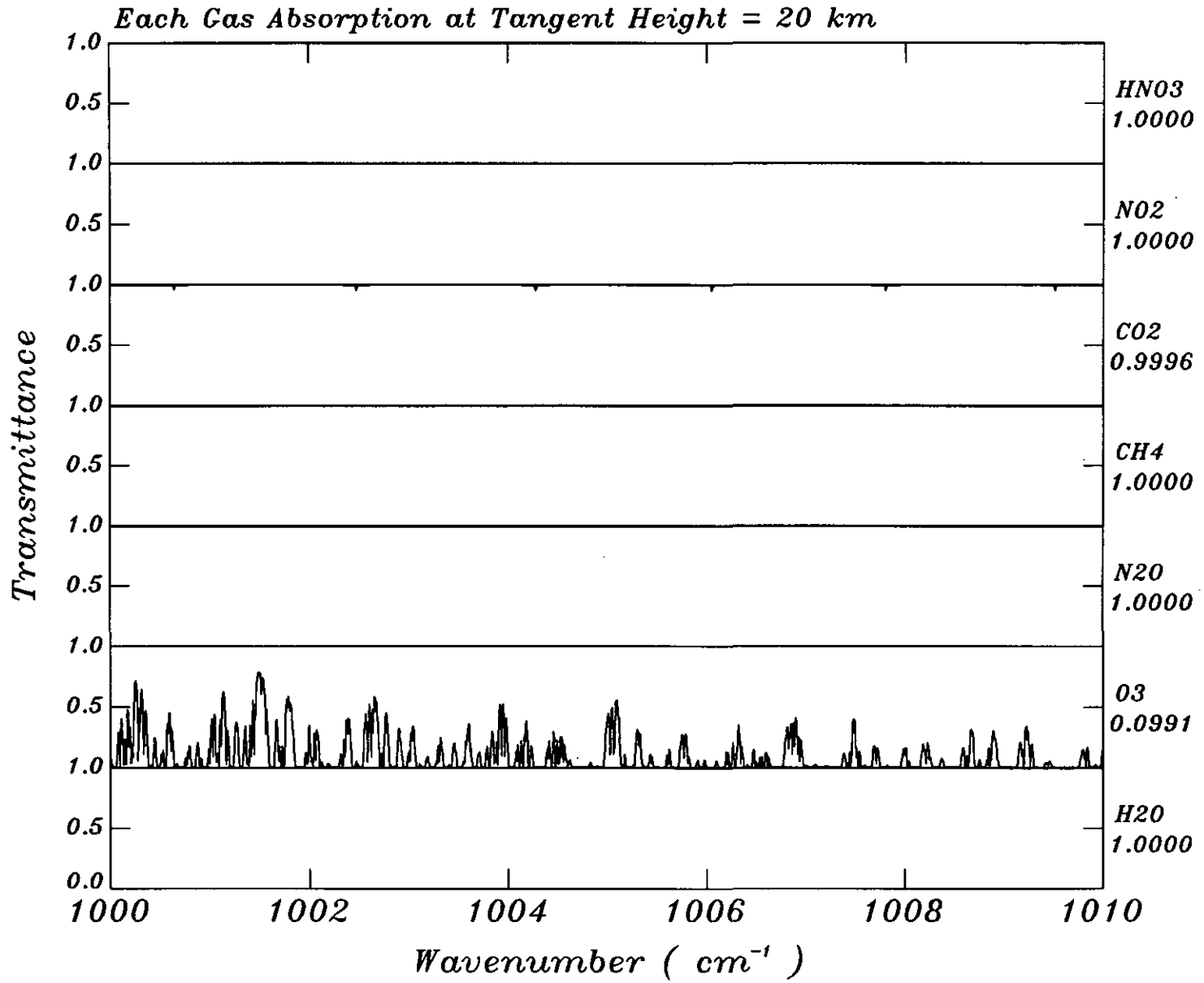

NO2
CO2
N2O
O3
H2O
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
50.km
.99751
40.km
.98654
30.km
.96135
20.km
.88083
10.km
.56056
line#
764
970
972
974
976
978
980
Transmittance
Wavenumber (cm⁻¹)

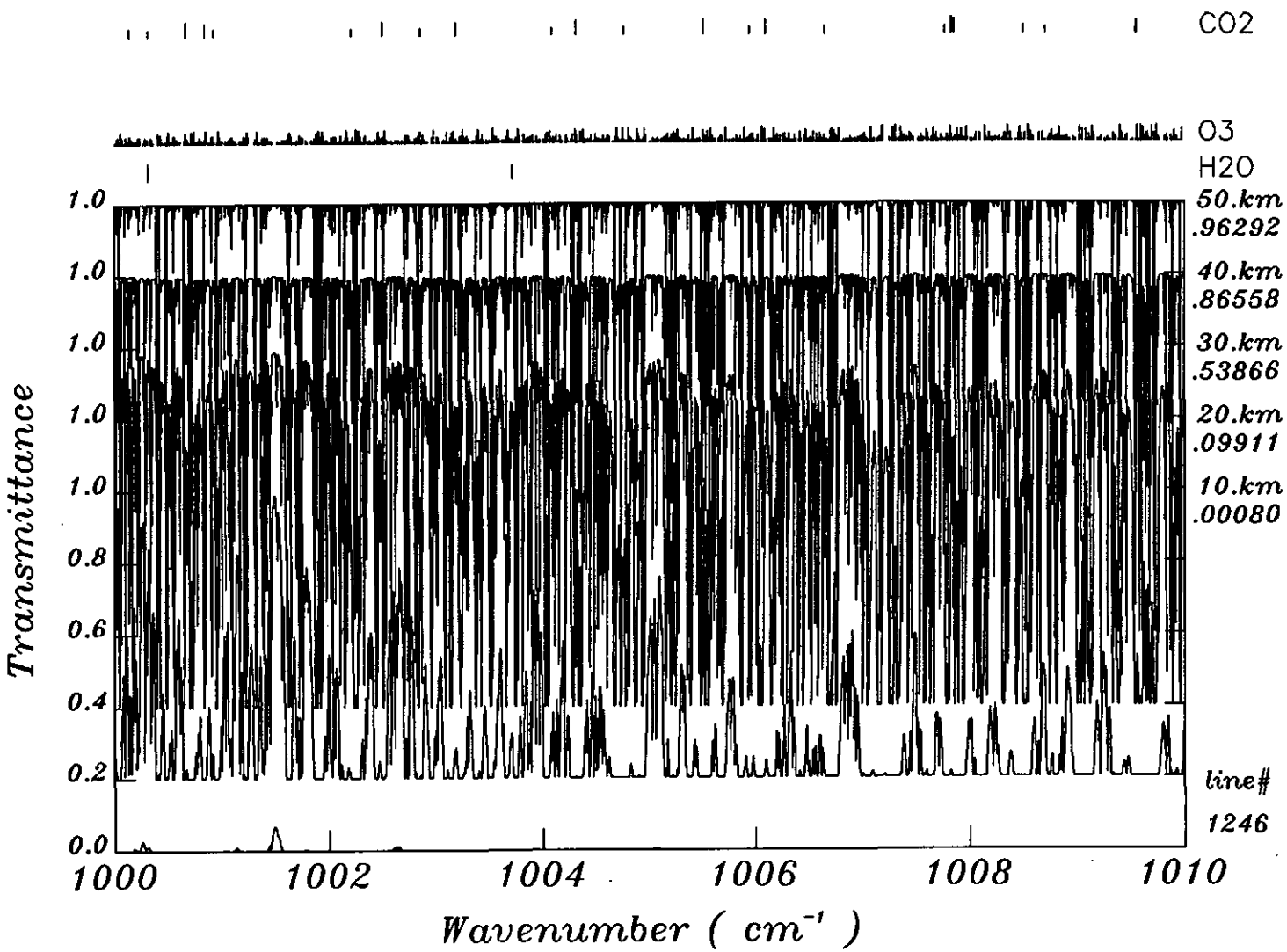

NO2
CO2
O3
H2O
50.km
.99340
40.km
.95957
30.km
.87604
20.km
.65471
10.km
.21745
line#
941
1.0
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
Transmittance
980
982
984
986
988
990
Wavenumber (cm⁻¹)

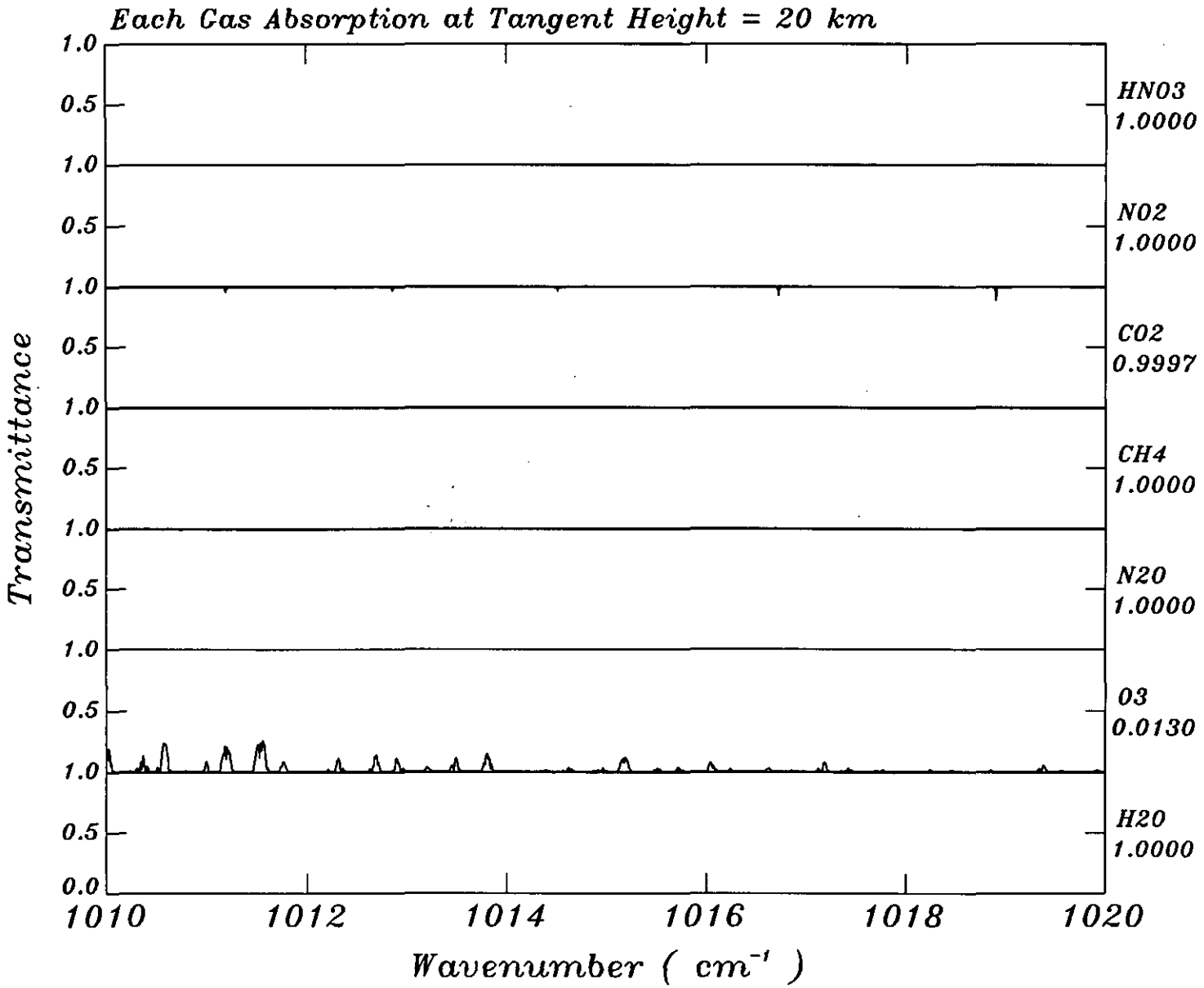

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
0.5
0.0
HNO3
1.0000
NO2
1.0000
CO2
0.9923
CH4
1.0000
N2O
1.0000
O3
0.6606
H2O
1.0000
980
982
984
986
988
990
Wavenumber (cm⁻¹)

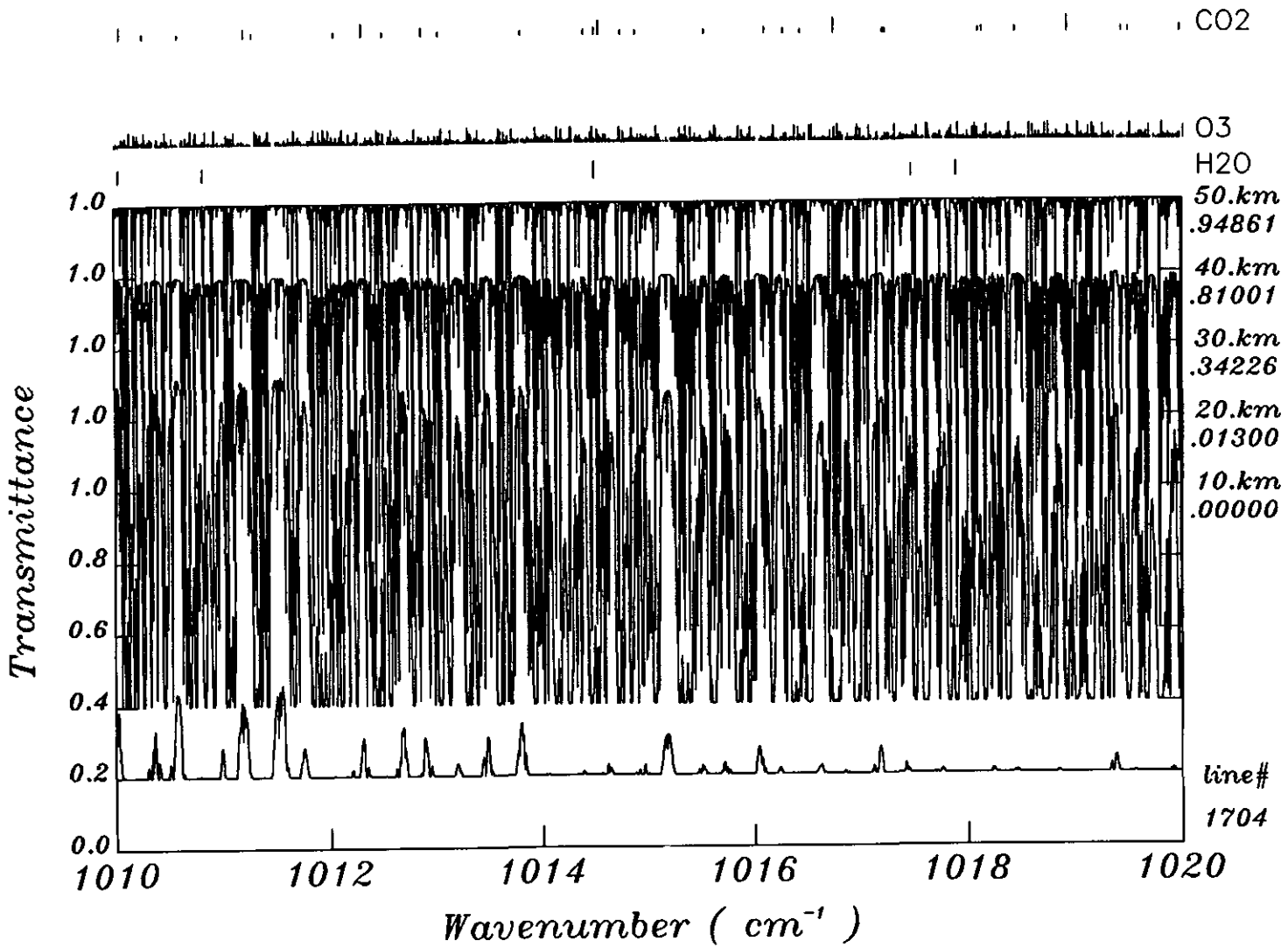

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
0.5
0.0
HNO3
1.0000
NO2
1.0000
CO2
0.9997
CH4
1.0000
N2O
1.0000
O3
0.3549
H2O
1.0000
990
992
994
996
998
1000
Wavenumber (cm⁻¹)

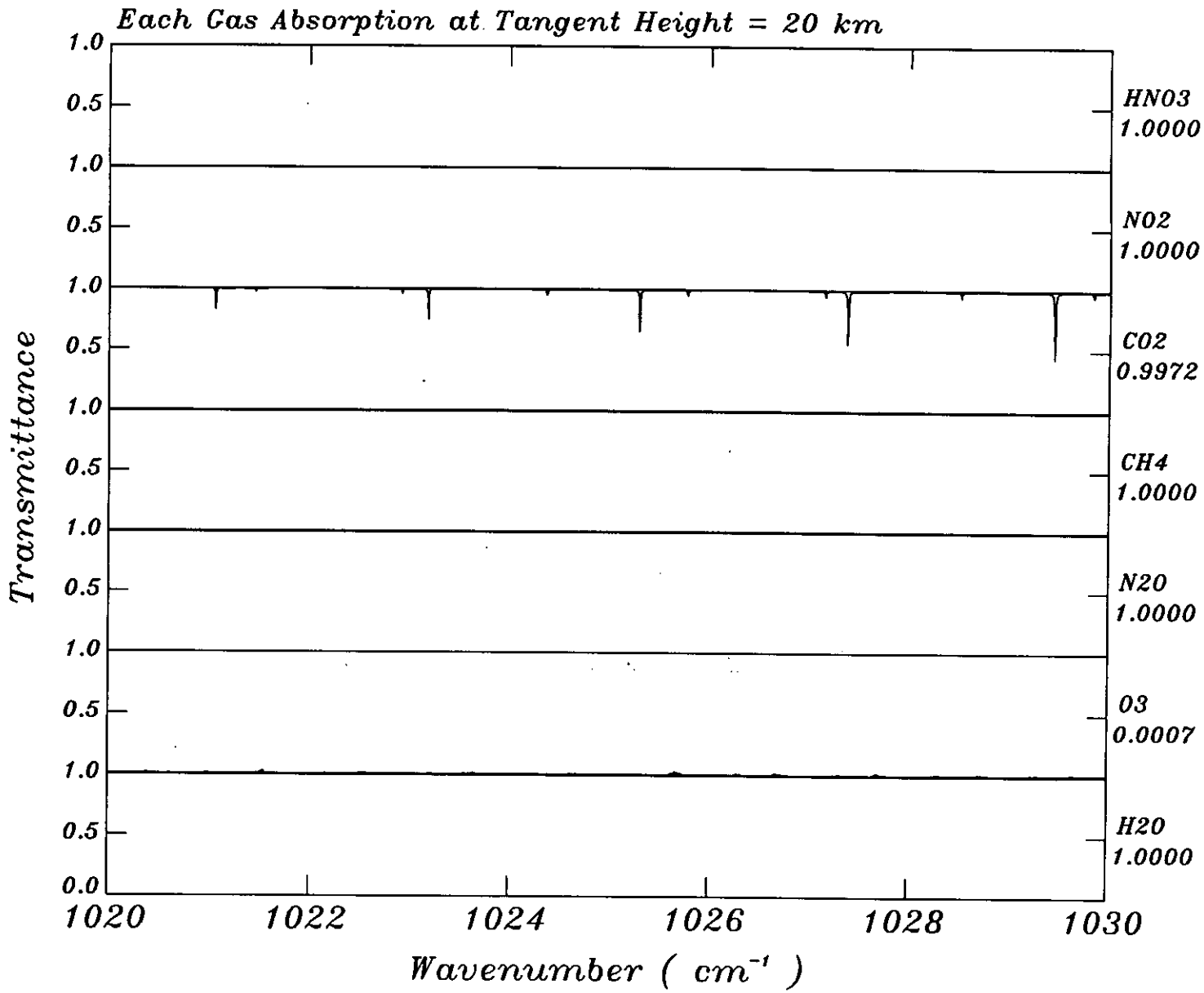

CO2
O3
H2O
50.km
.98097
40.km
.91609
30.km
.73497
20.km
.35478
10.km
.03309
line#
1007
Transmittance
1.0
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
990
992
994
996
998
1000
Wavenumber (cm⁻¹)

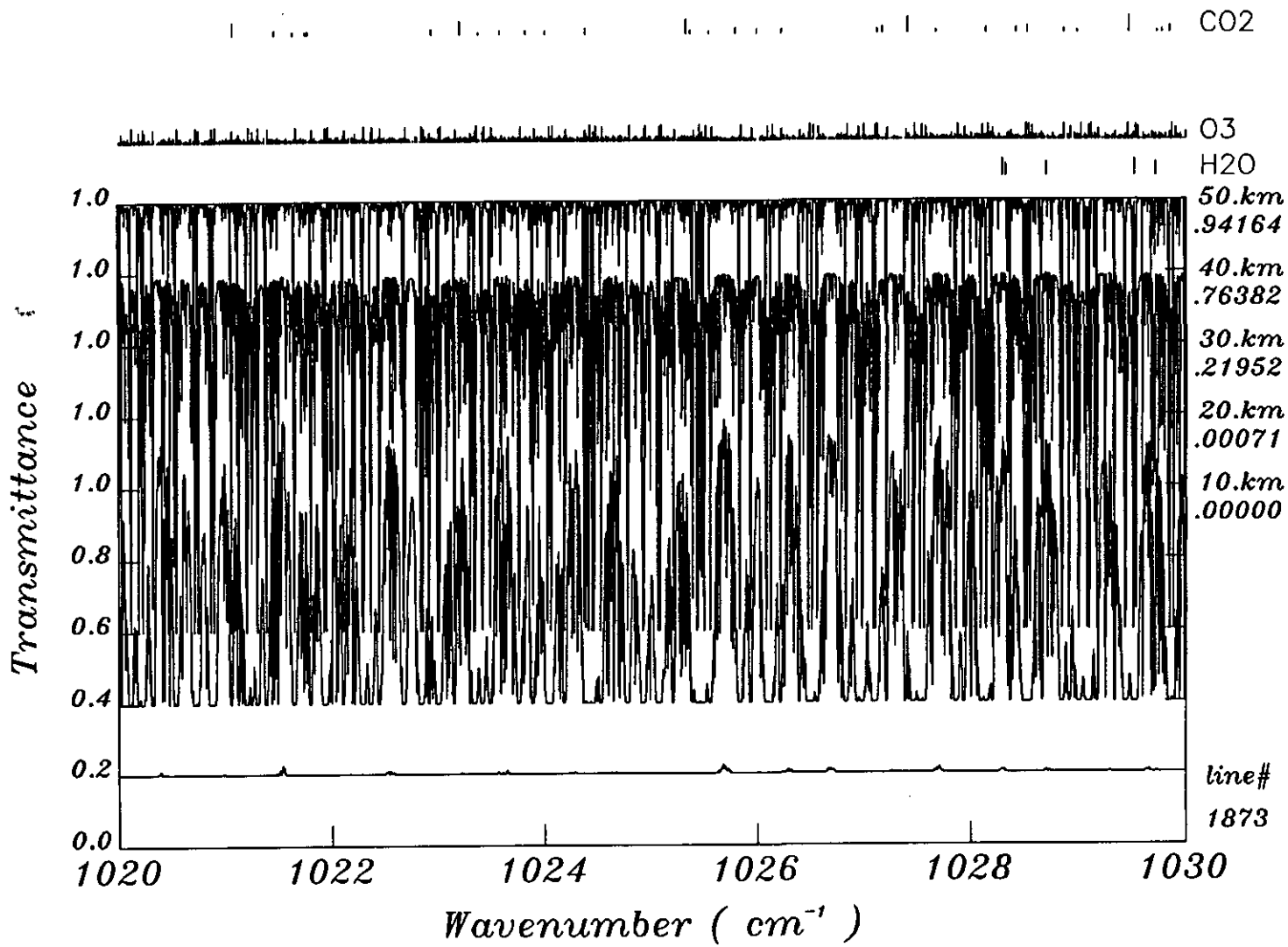

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
0.5
0.0
HNO3
1.0000
NO2
1.0000
CO2
0.9996
CH4
1.0000
N2O
1.0000
O3
0.0991
H2O
1.0000
1000
1002
1004
1006
1008
1010
Wavenumber (cm⁻¹)

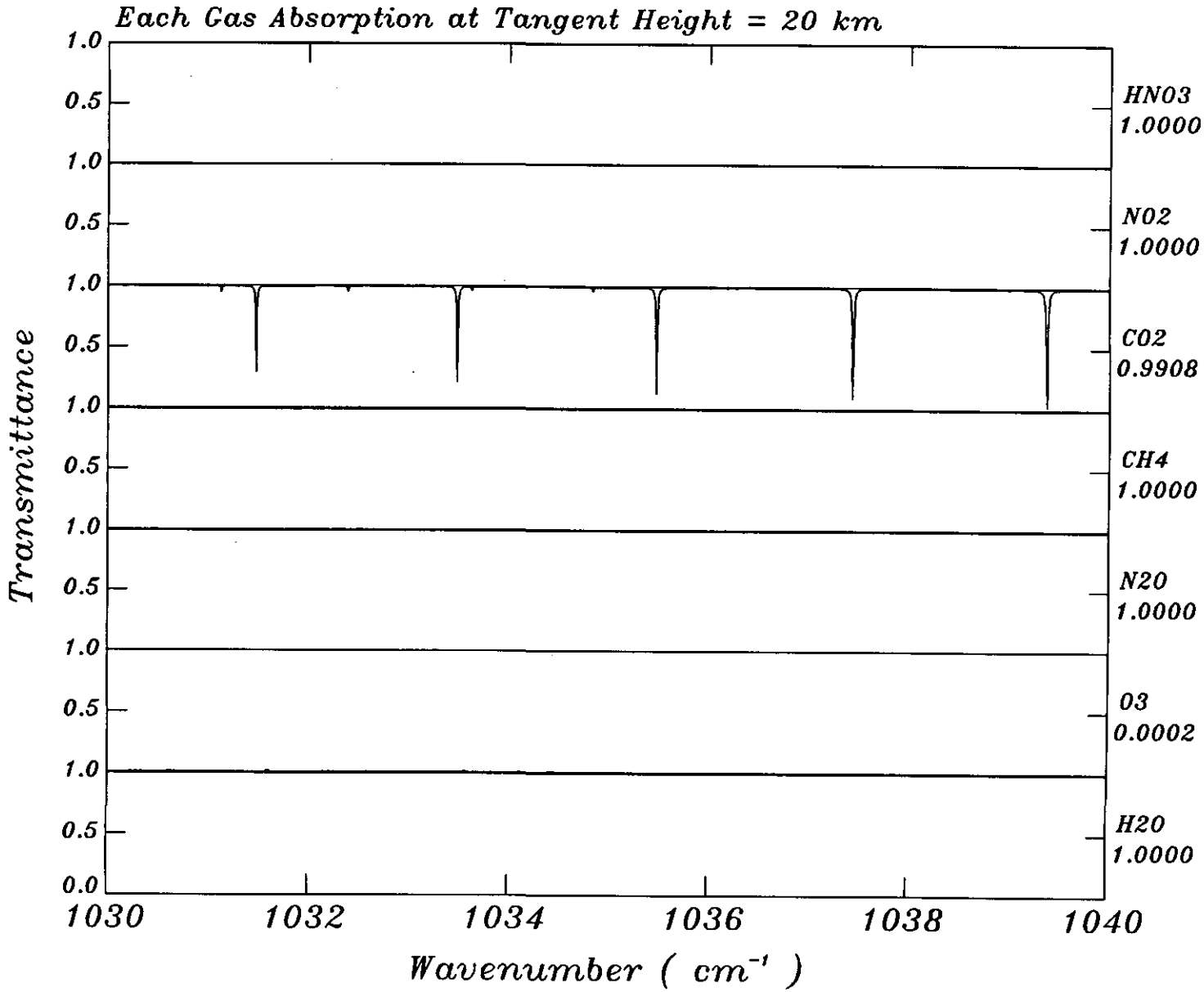

CO2
O3
H2O
50.km
.96292
40.km
.86558
30.km
.53866
20.km
.09911
10.km
.00080
line#
1246
Transmittance
1.0
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
1000
1002
1004
1006
1008
1010
Wavenumber (cm⁻¹)

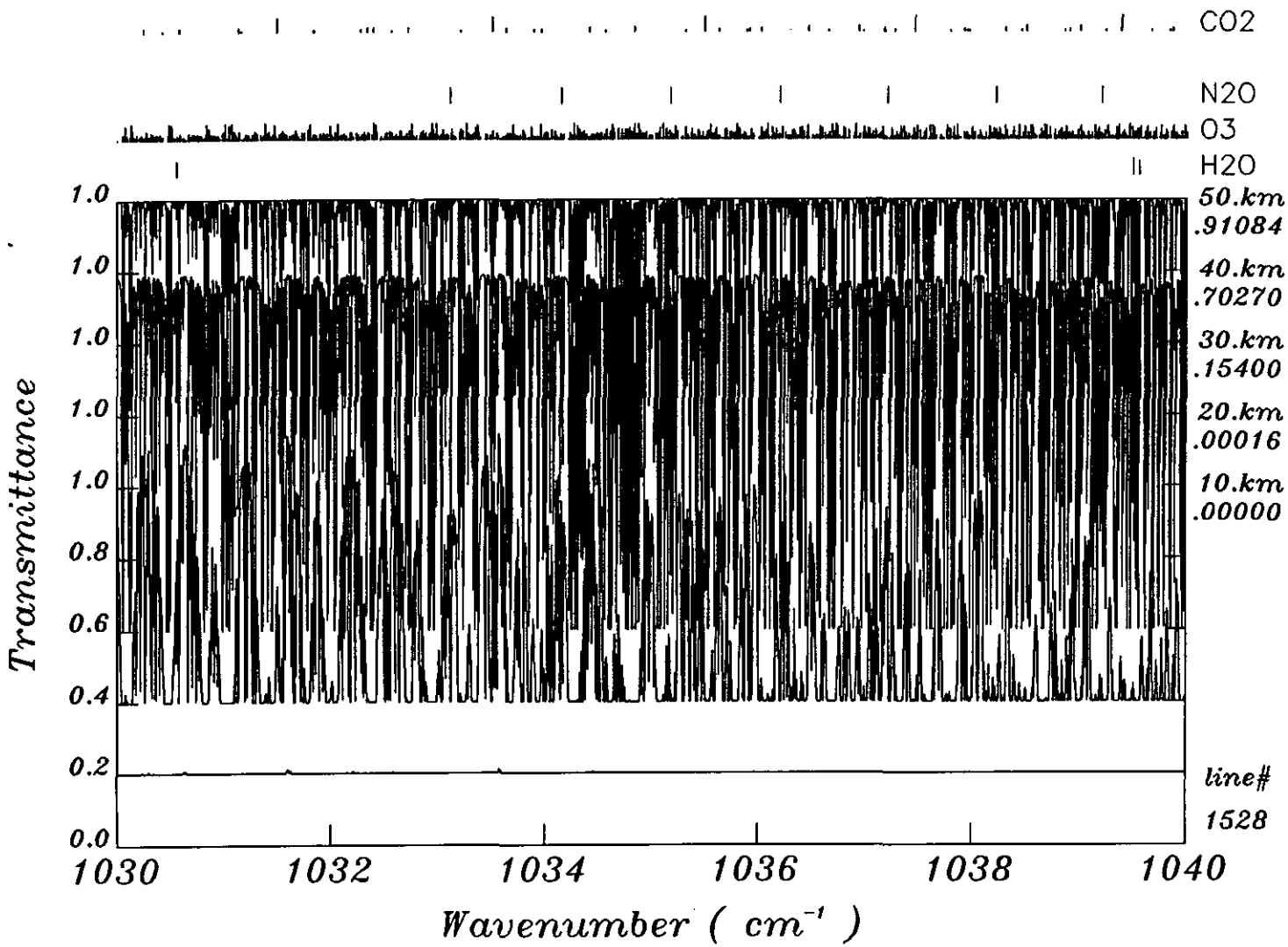

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
0.5
0.0
HN03
1.0000
N02
1.0000
C02
0.9997
CH4
1.0000
N20
1.0000
03
0.0130
H20
1.0000
1010
1012
1014
1016
1018
1020
Wavenumber (cm⁻¹)

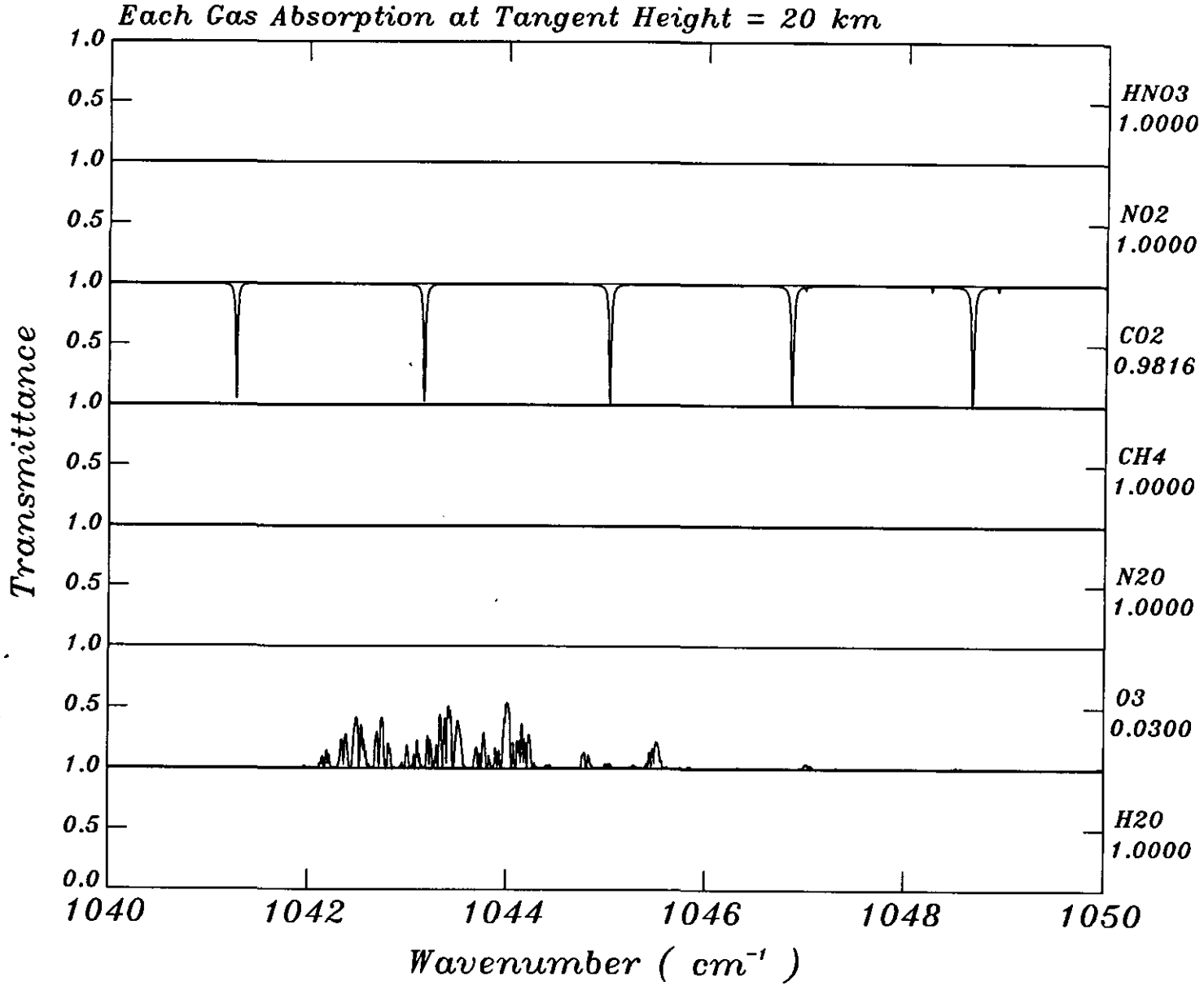

CO2
O3
H2O
50.km
.94861
40.km
.81001
30.km
.34226
20.km
.01300
10.km
.00000
line#
1704
Transmittance
1.0
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
1010
1012
1014
1016
1018
1020
Wavenumber (cm⁻¹)

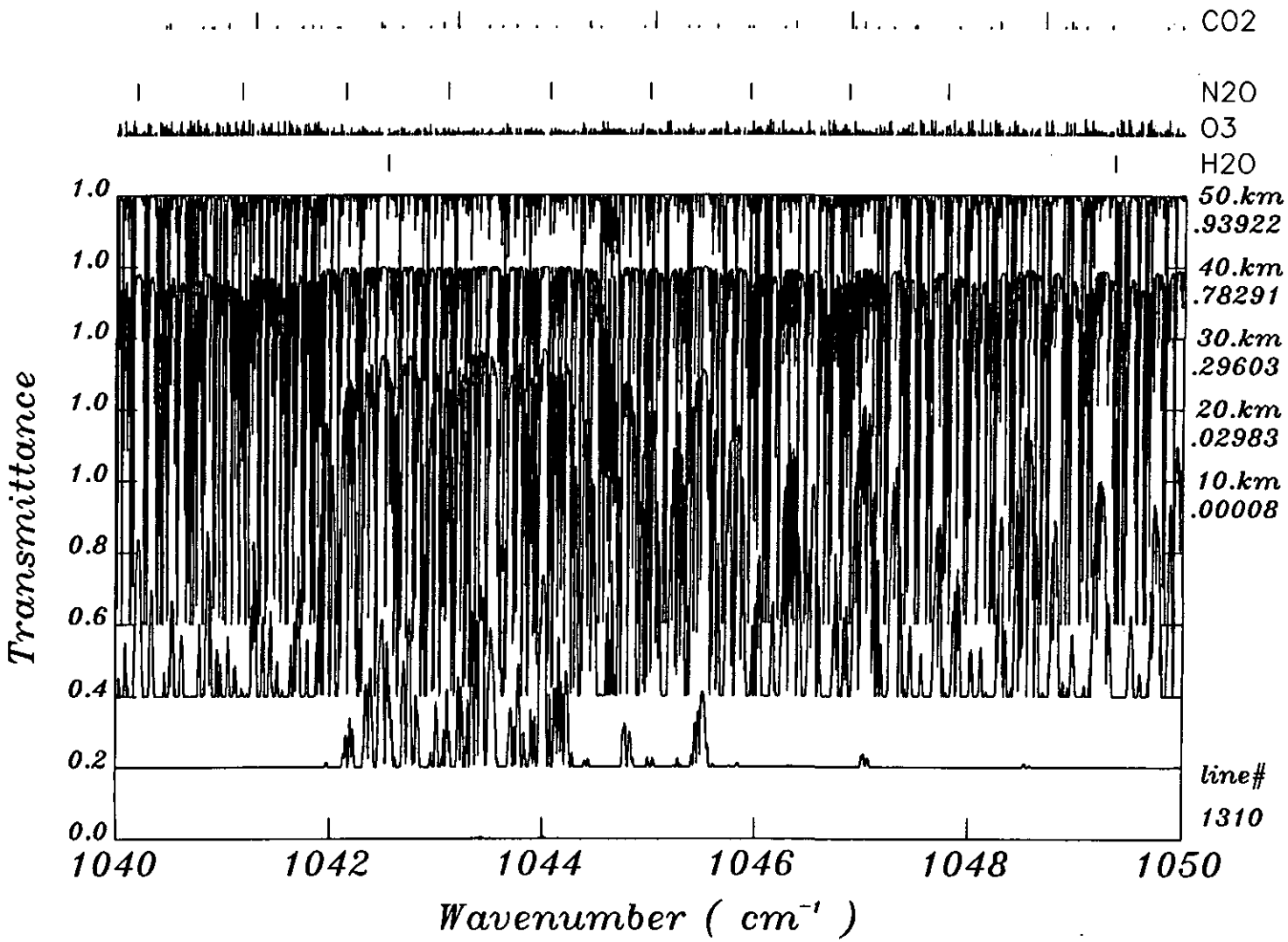

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
0.5
0.0
HN03
1.0000
NO2
1.0000
CO2
0.9972
CH4
1.0000
N20
1.0000
03
0.0007
H20
1.0000
1020
1022
1024
1026
1028
1030
Wavenumber (cm⁻¹)

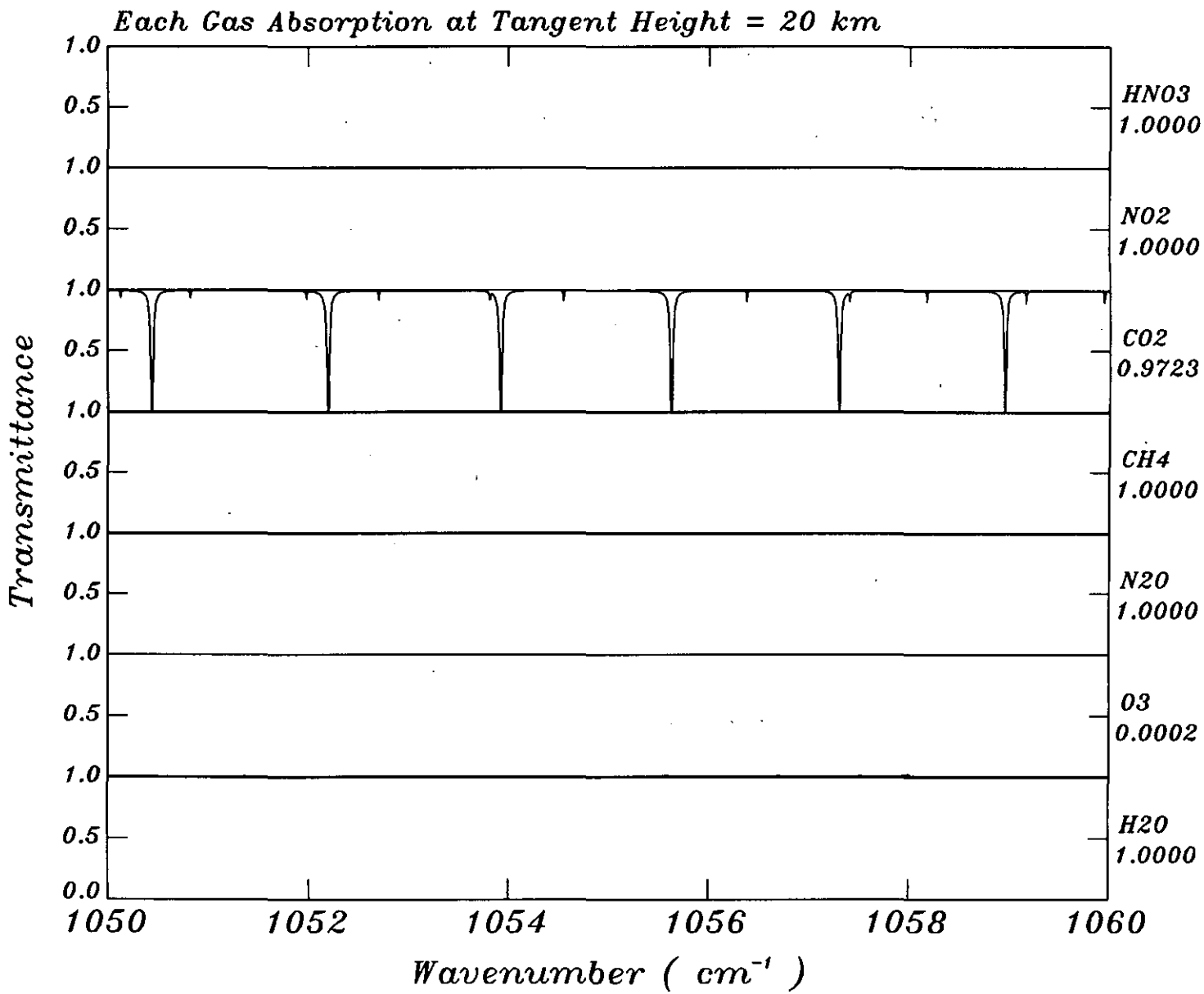

CO2
O3
H2O
50.km
.94164
40.km
.76382
30.km
.21952
20.km
.00071
10.km
.00000
line#
1873
Transmittance
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
1020
1022
1024
1026
1028
1030
Wavenumber (cm⁻¹)

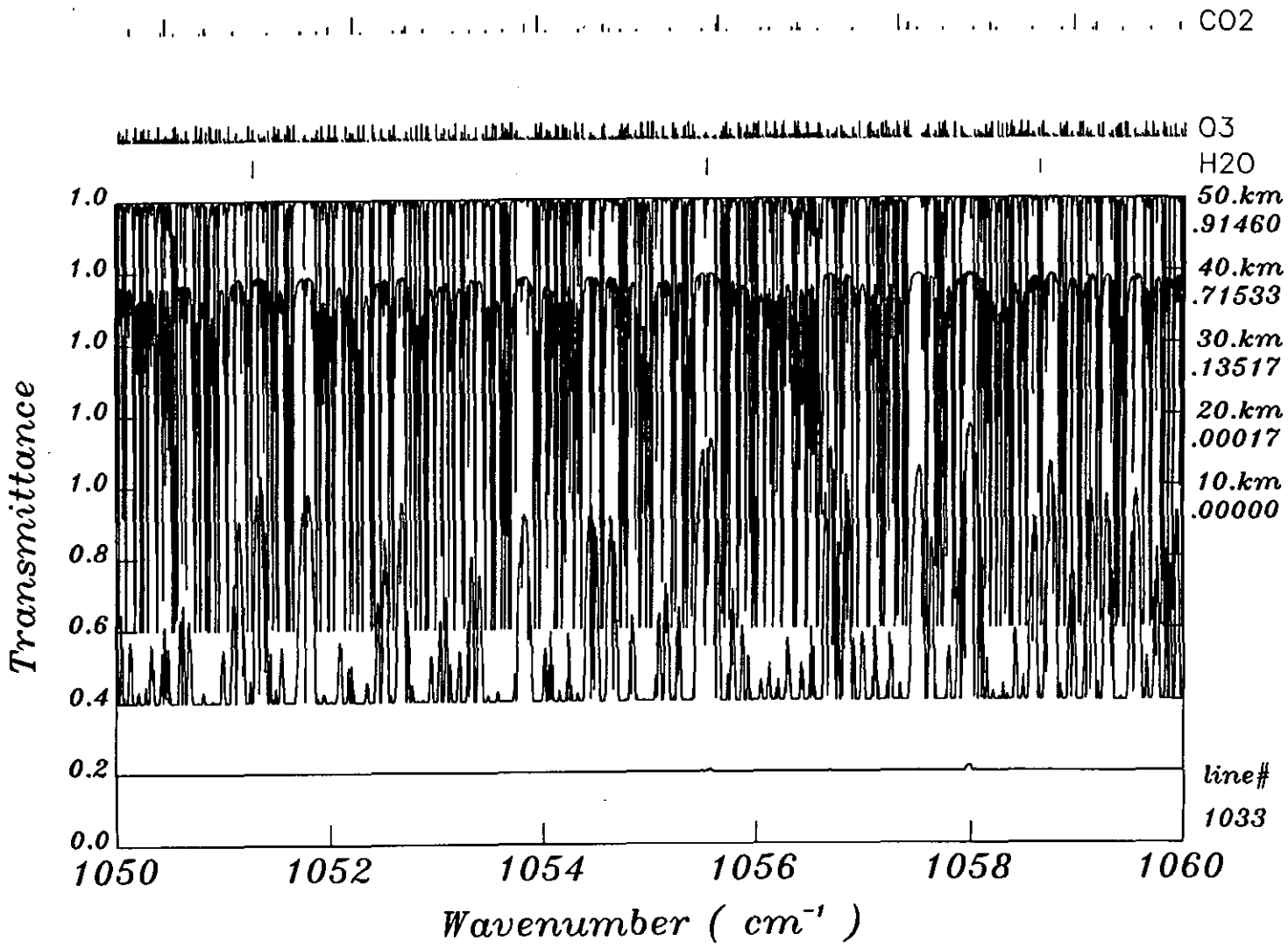

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
0.5
0.0
HN03
1.0000
N02
1.0000
C02
0.9908
CH4
1.0000
N20
1.0000
03
0.0002
H20
1.0000
1030
1032
1034
1036
1038
1040
Wavenumber (cm⁻¹)

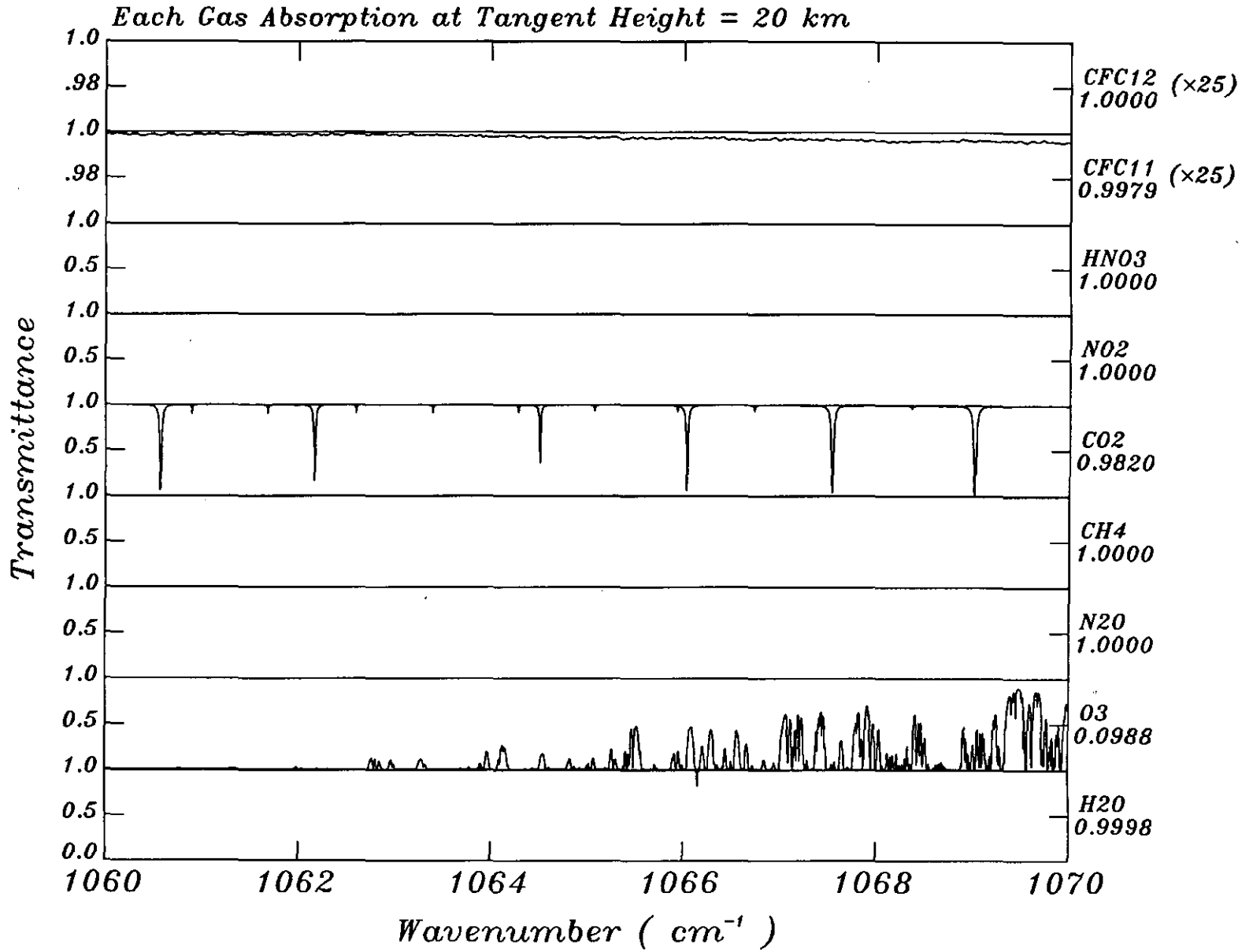

CO2
N2O
O3
H2O
50.km
.91084
40.km
.70270
30.km
.15400
20.km
.00016
10.km
.00000
line#
1528
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
Transmittance
1030
1032
1034
1036
1038
1040
Wavenumber (cm⁻¹)

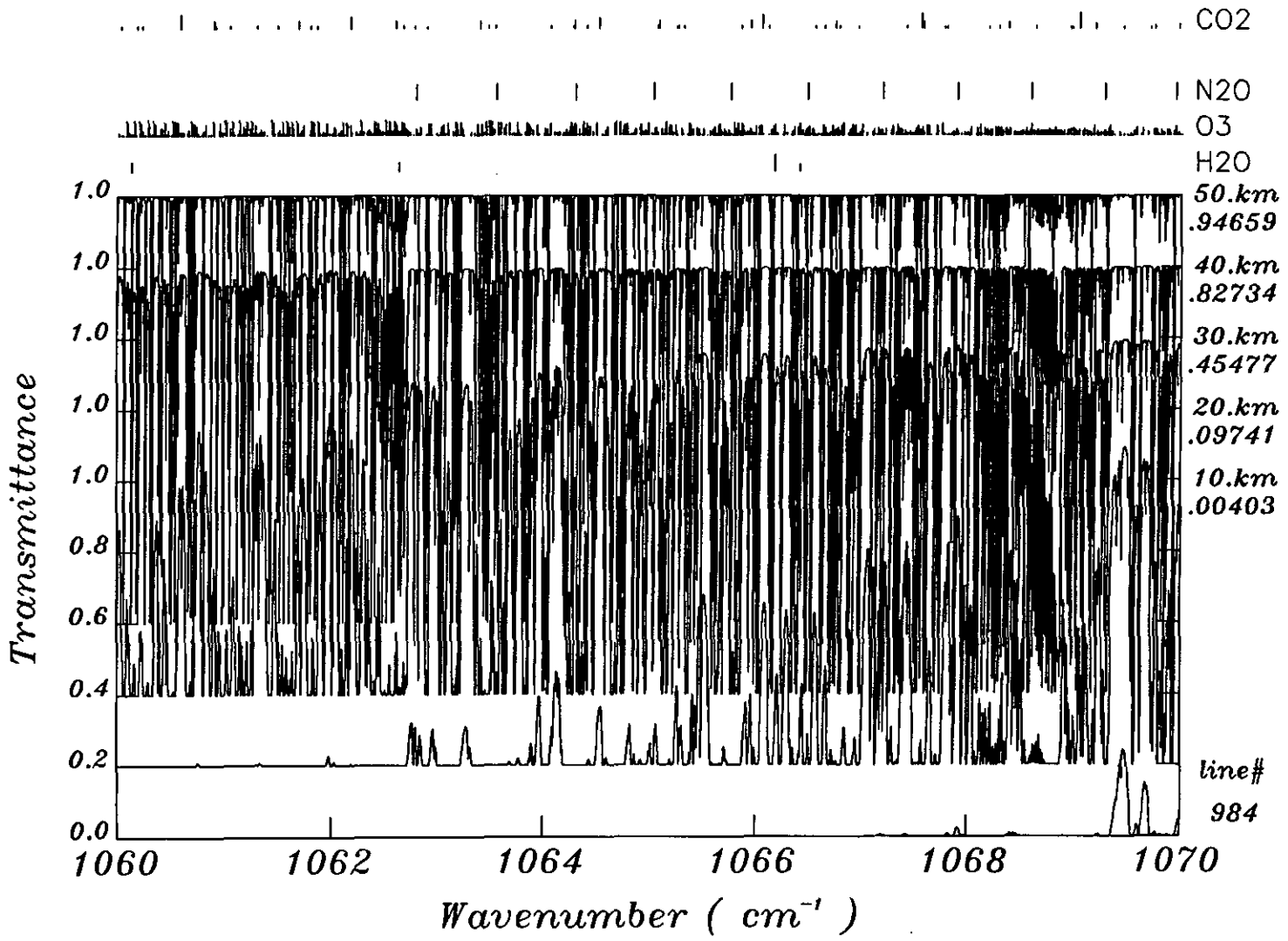

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
0.5
0.0
HNO3
1.0000
NO2
1.0000
CO2
0.9816
CH4
1.0000
N2O
1.0000
O3
0.0300
H2O
1.0000
1040
1042
1044
1046
1048
1050
Wavenumber (cm⁻¹)

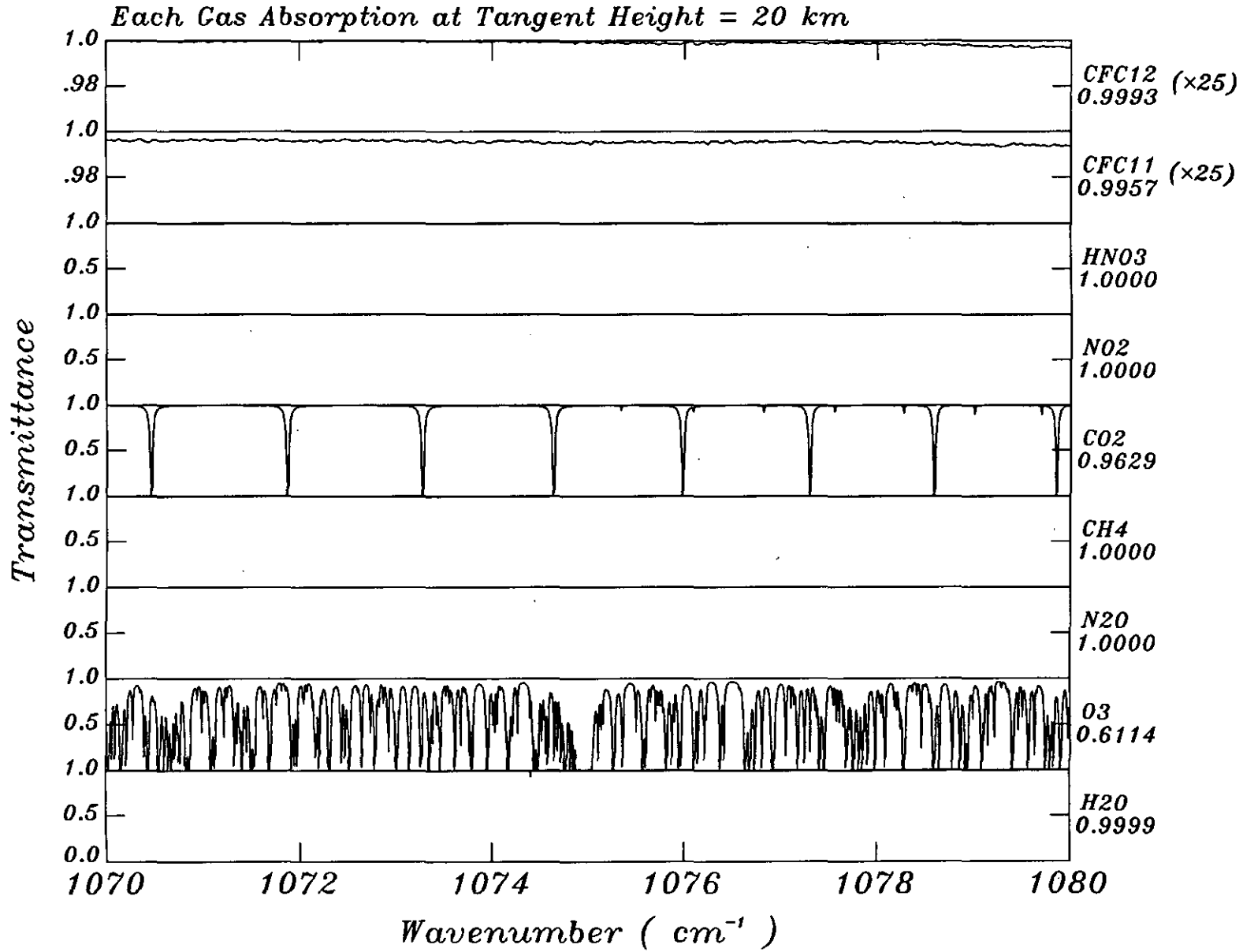

CO2
N2O
O3
H2O
50.km
.93922
40.km
.78291
30.km
.29603
20.km
.02983
10.km
.00008
line#
1310
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
Transmittance
1040
1042
1044
1046
1048
1050
Wavenumber (cm⁻¹)

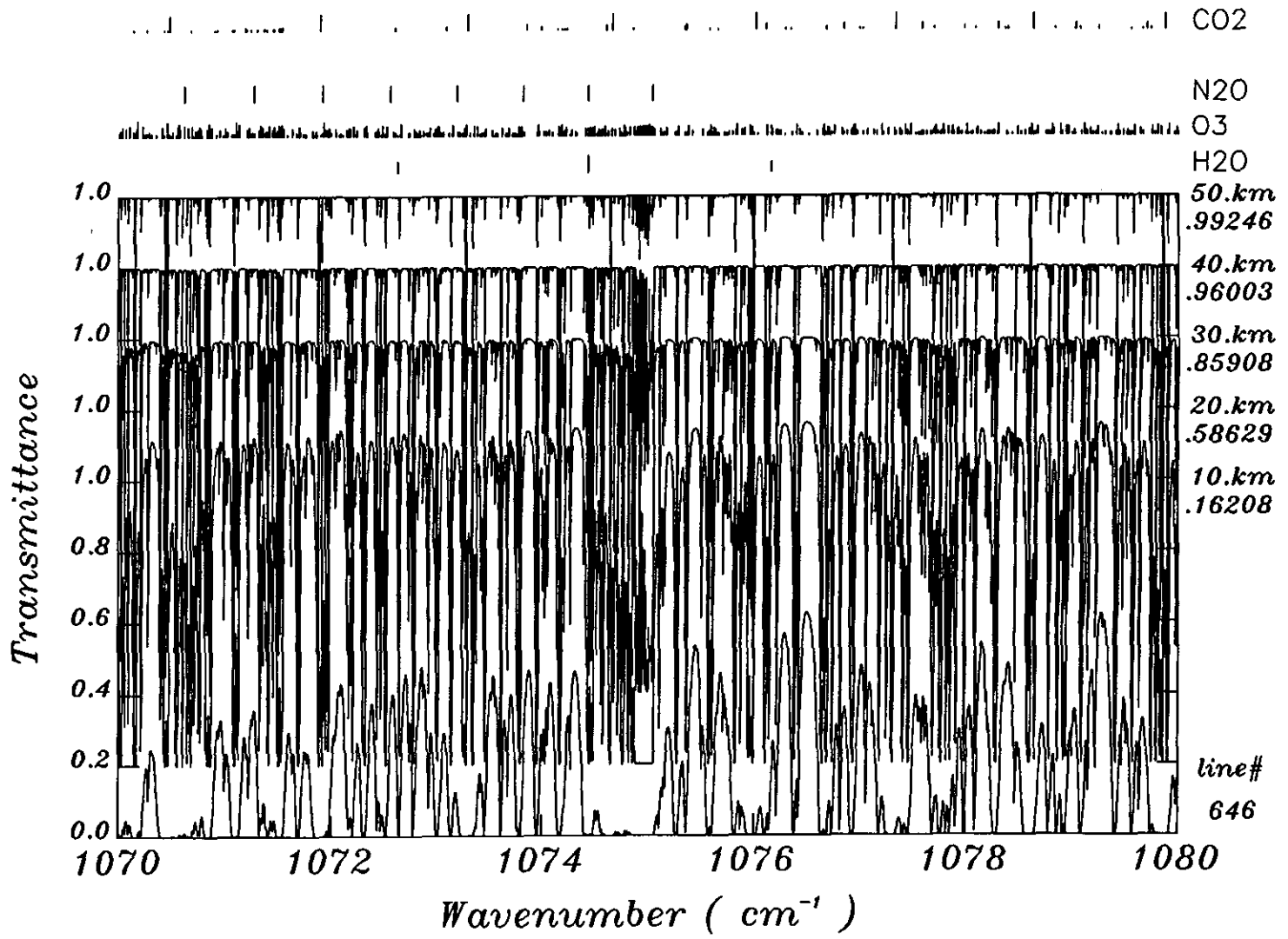

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
0.5
0.0
HNO3
1.0000
NO2
1.0000
CO2
0.9723
CH4
1.0000
N2O
1.0000
O3
0.0002
H2O
1.0000
1050
1052
1054
1056
1058
1060
Wavenumber (cm⁻¹)

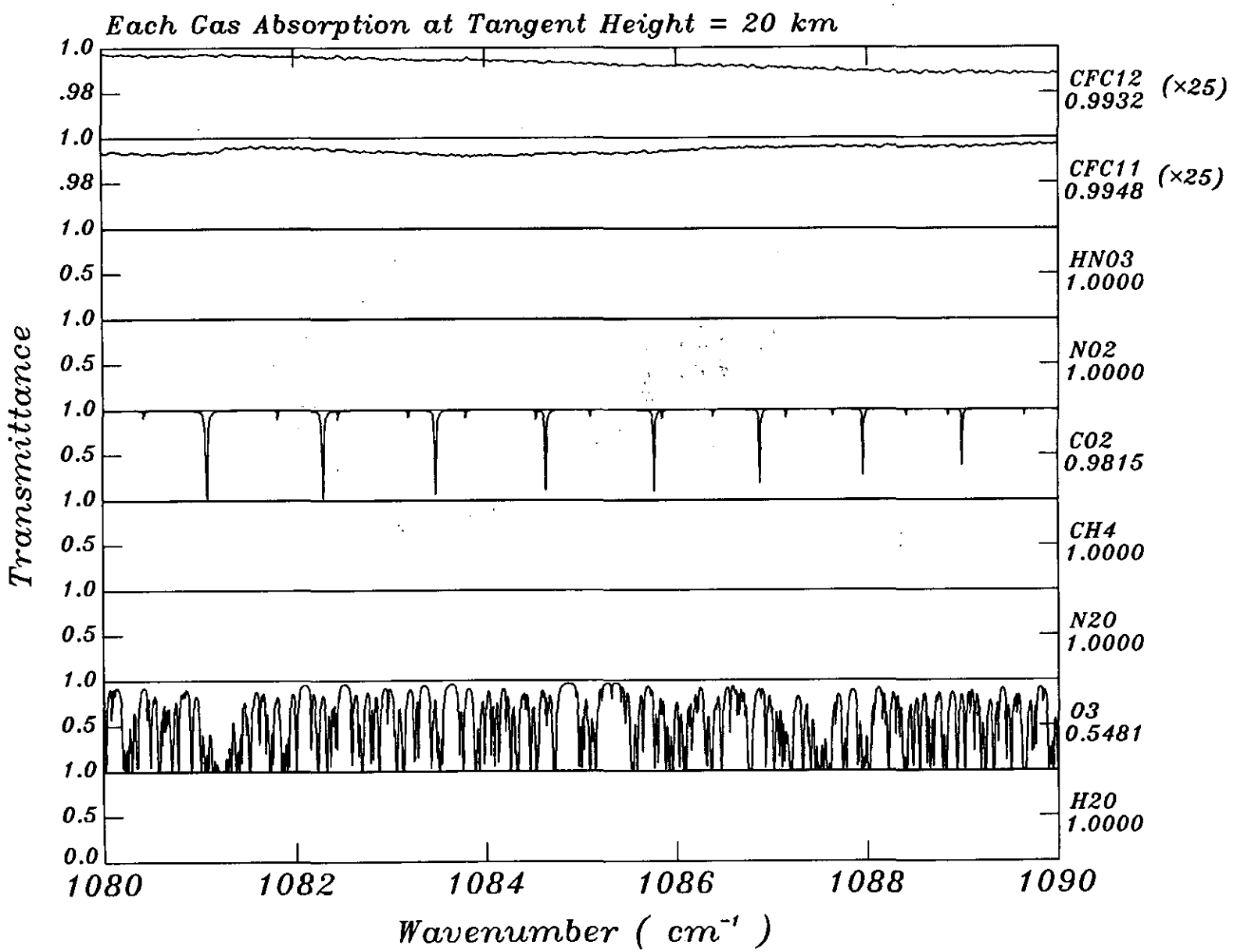

CO2
O3
H2O
50.km
.91460
40.km
.71533
30.km
.13517
20.km
.00017
10.km
.00000
line#
1033
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
Transmittance
1050
1052
1054
1056
1058
1060
Wavenumber (cm⁻¹)

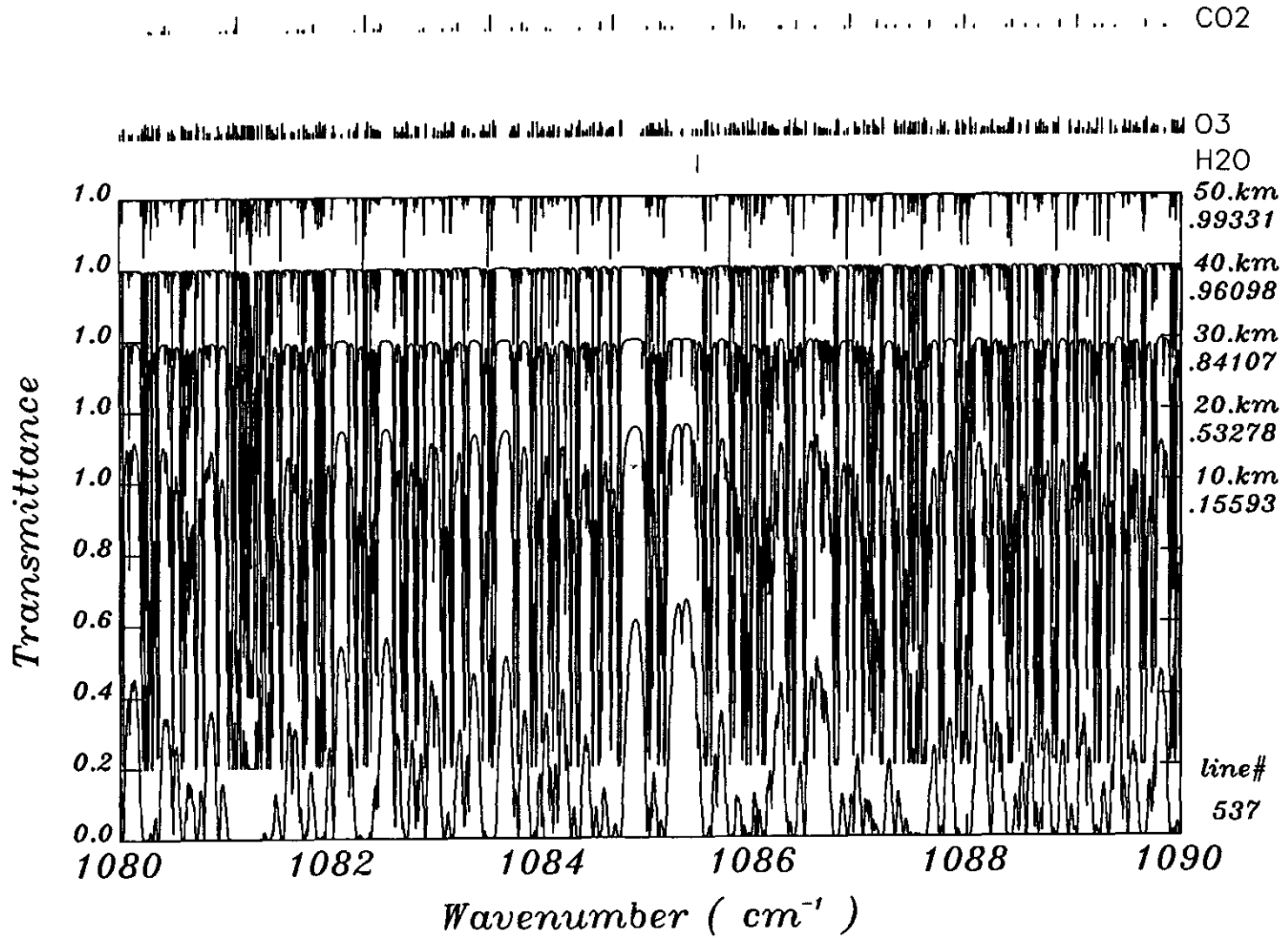

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
.98
1.0
.98
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
0.0
CFC12 (×25)
1.0000
CFC11 (×25)
0.9979
HNO3
1.0000
NO2
1.0000
CO2
0.9820
CH4
1.0000
N2O
1.0000
O3
0.0988
H2O
0.9998
1060
1062
1064
1066
1068
1070
Wavenumber (cm⁻¹)

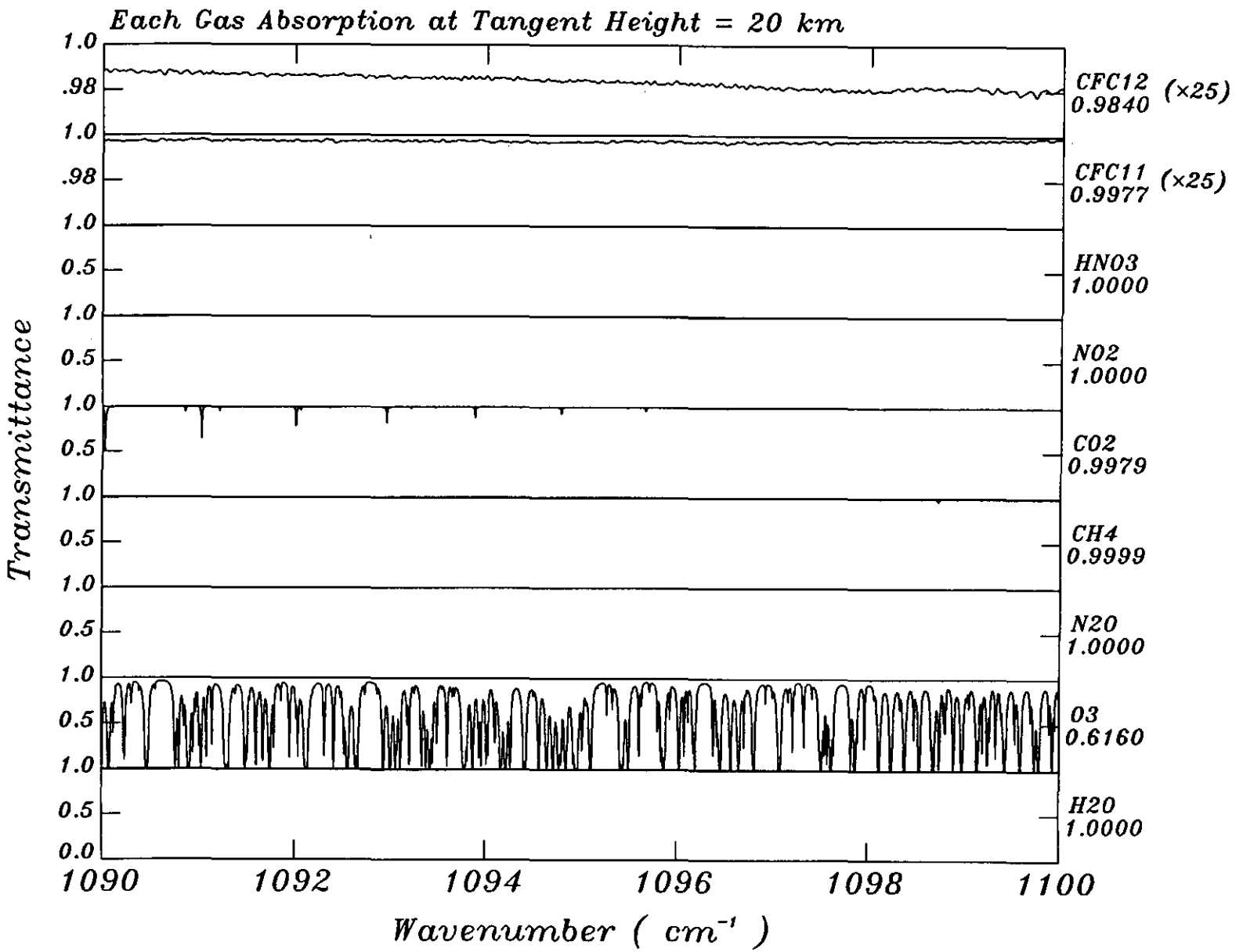

CO2
N2O
O3
H2O
50.km
.94659
40.km
.82734
30.km
.45477
20.km
.09741
10.km
.00403
line#
984
Transmittance
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
1060
1062
1064
1066
1068
1070
Wavenumber (cm⁻¹)

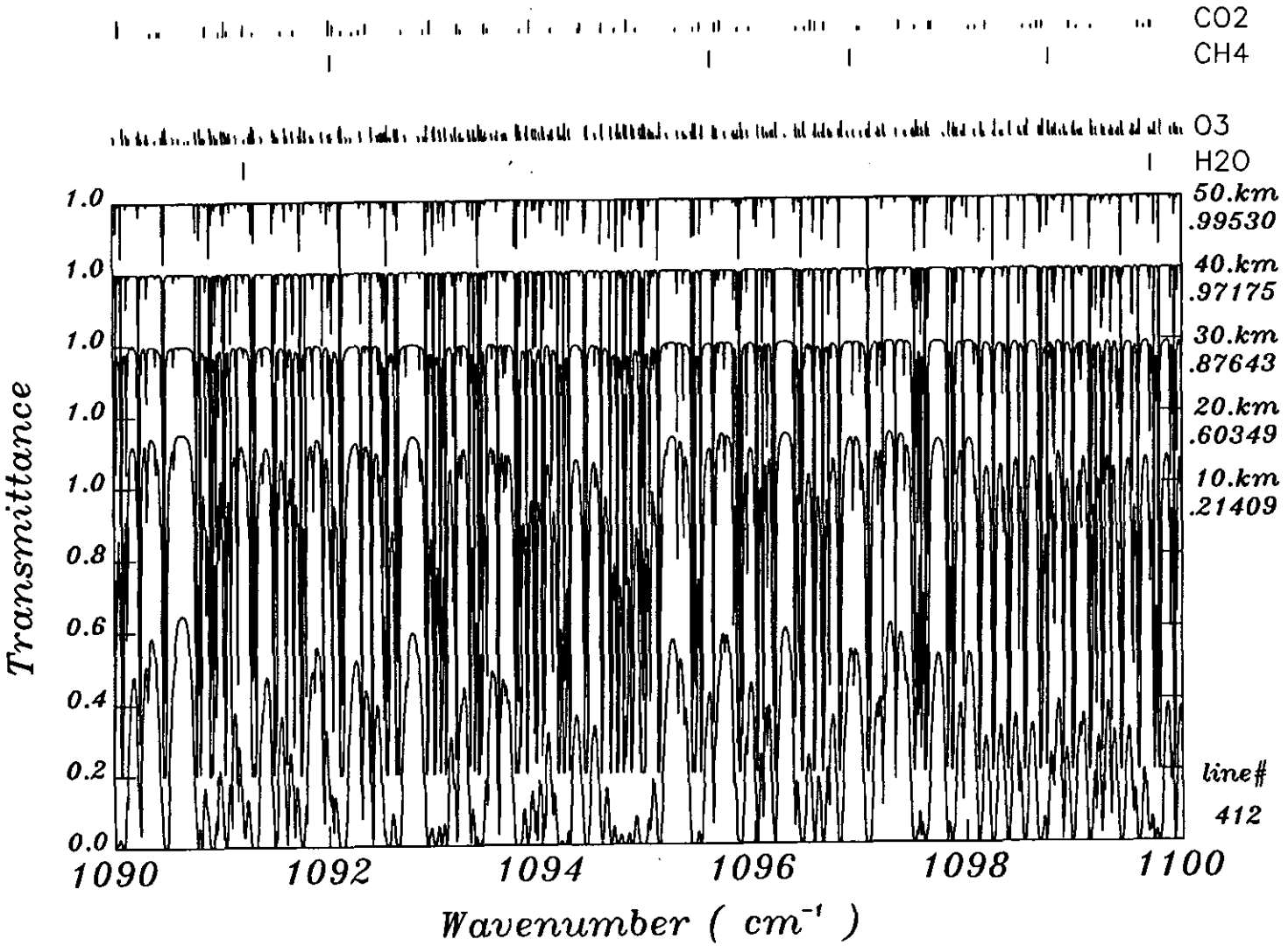

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
.98
1.0
.98
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
0.0
CFC12 (×25)
0.9993
CFC11 (×25)
0.9957
HN03
1.0000
N02
1.0000
C02
0.9629
CH4
1.0000
N20
1.0000
03
0.6114
H20
0.9999
1070
1072
1074
1076
1078
1080
Wavenumber (cm⁻¹)

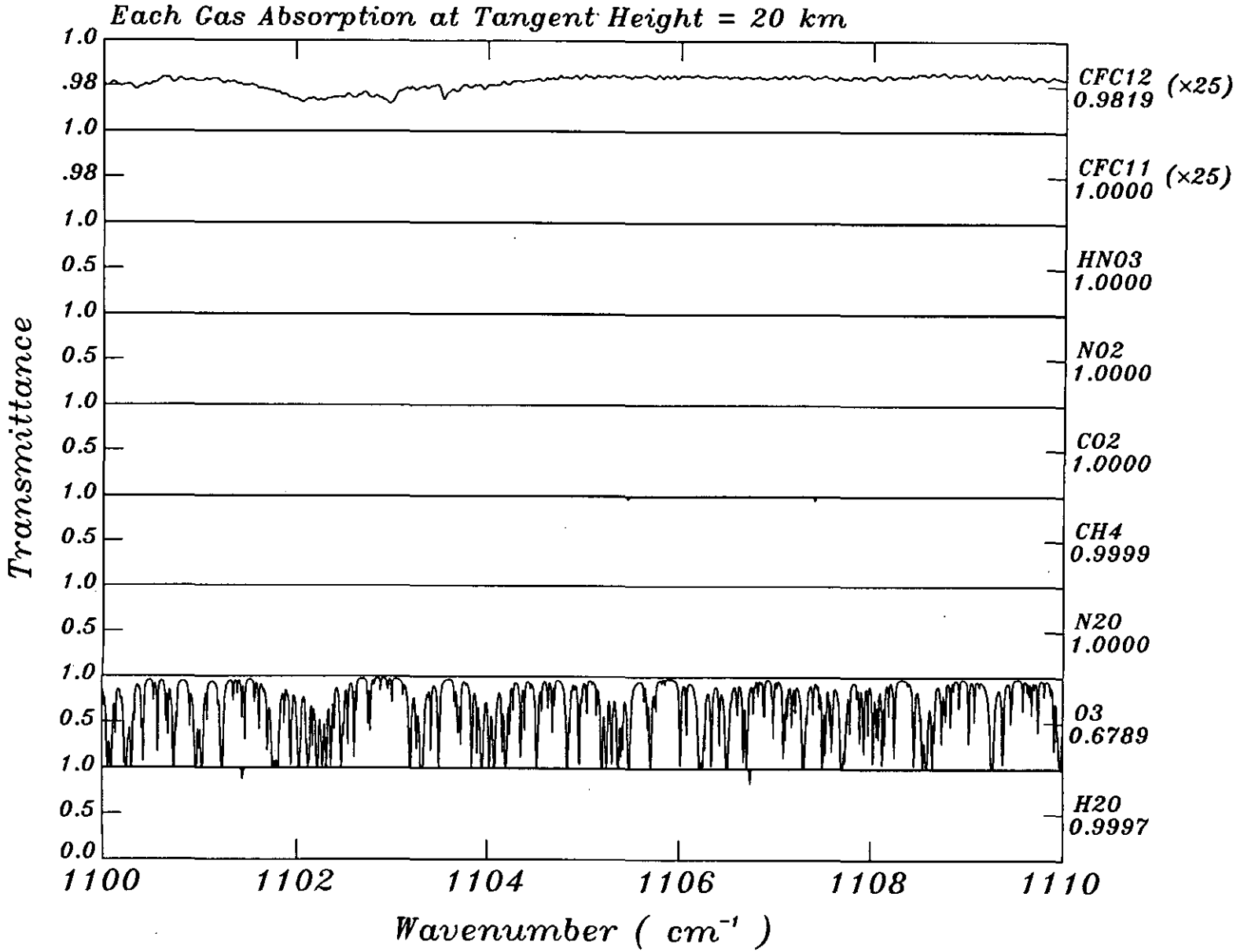

CO2
N2O
O3
H2O
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
Transmittance
50.km
.99246
40.km
.96003
30.km
.85908
20.km
.58629
10.km
.16208
line#
646
1070
1072
1074
1076
1078
1080
Wavenumber (cm⁻¹)

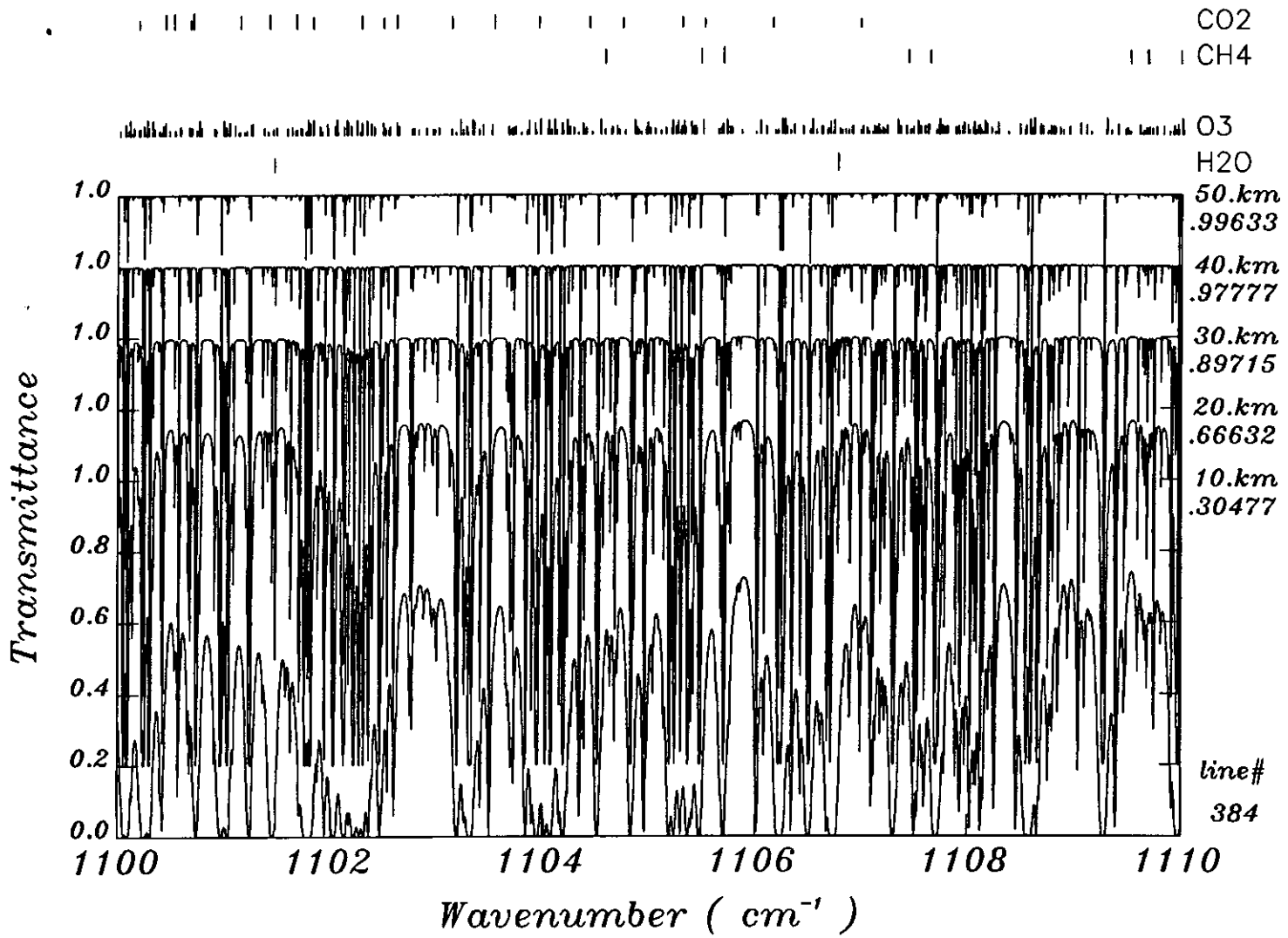

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
.98
1.0
.98
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
0.0
CFC12 (×25)
0.9932
CFC11 (×25)
0.9948
HN03
1.0000
N02
1.0000
C02
0.9815
CH4
1.0000
N20
1.0000
03
0.5481
H20
1.0000
1080
1082
1084
1086
1088
1090
Wavenumber (cm⁻¹)

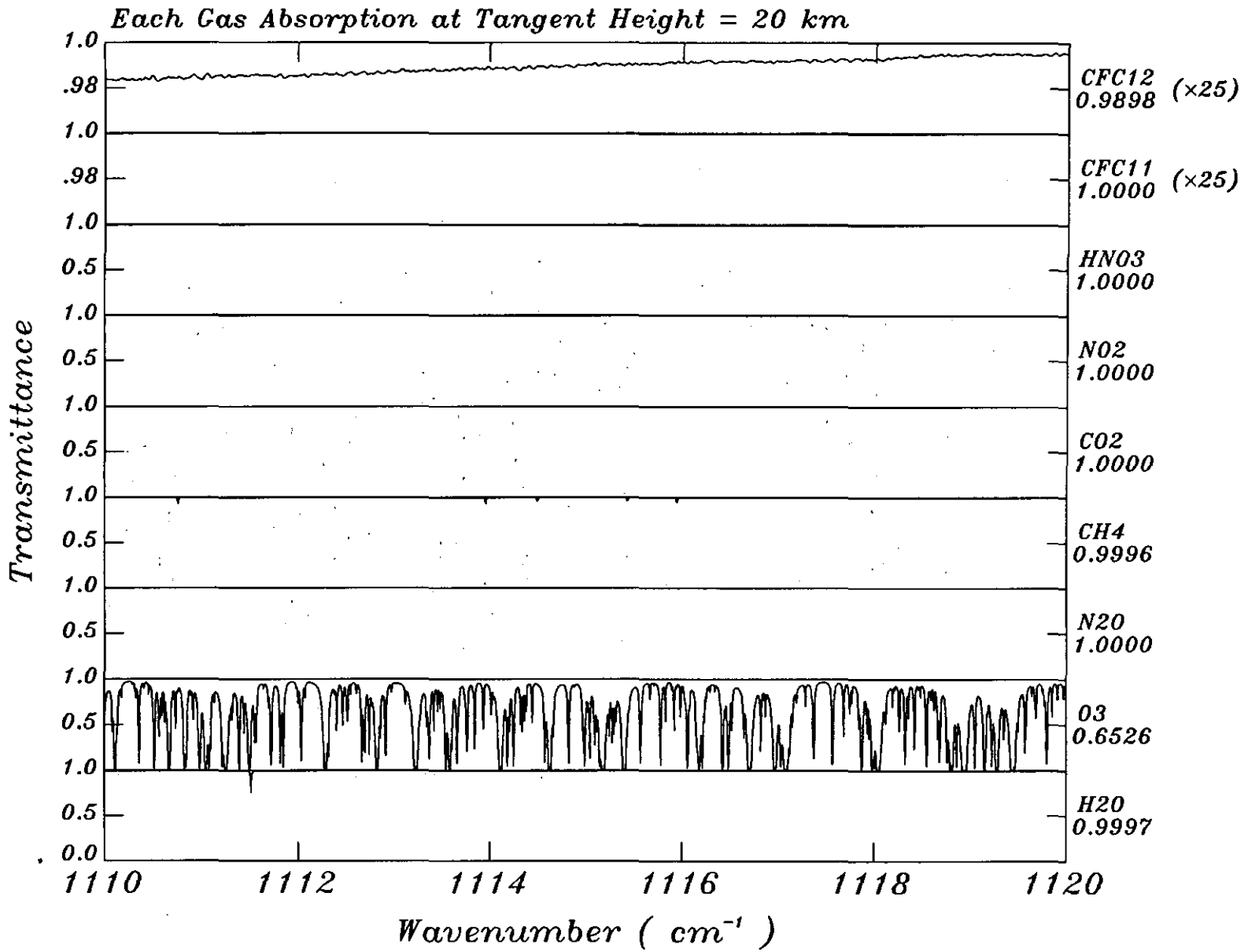

CO2
O3
H2O
50.km
.99331
40.km
.96098
30.km
.84107
20.km
.53278
10.km
.15593
line#
537
1.0
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
Transmittance
1080
1082
1084
1086
1088
1090
Wavenumber (cm⁻¹)

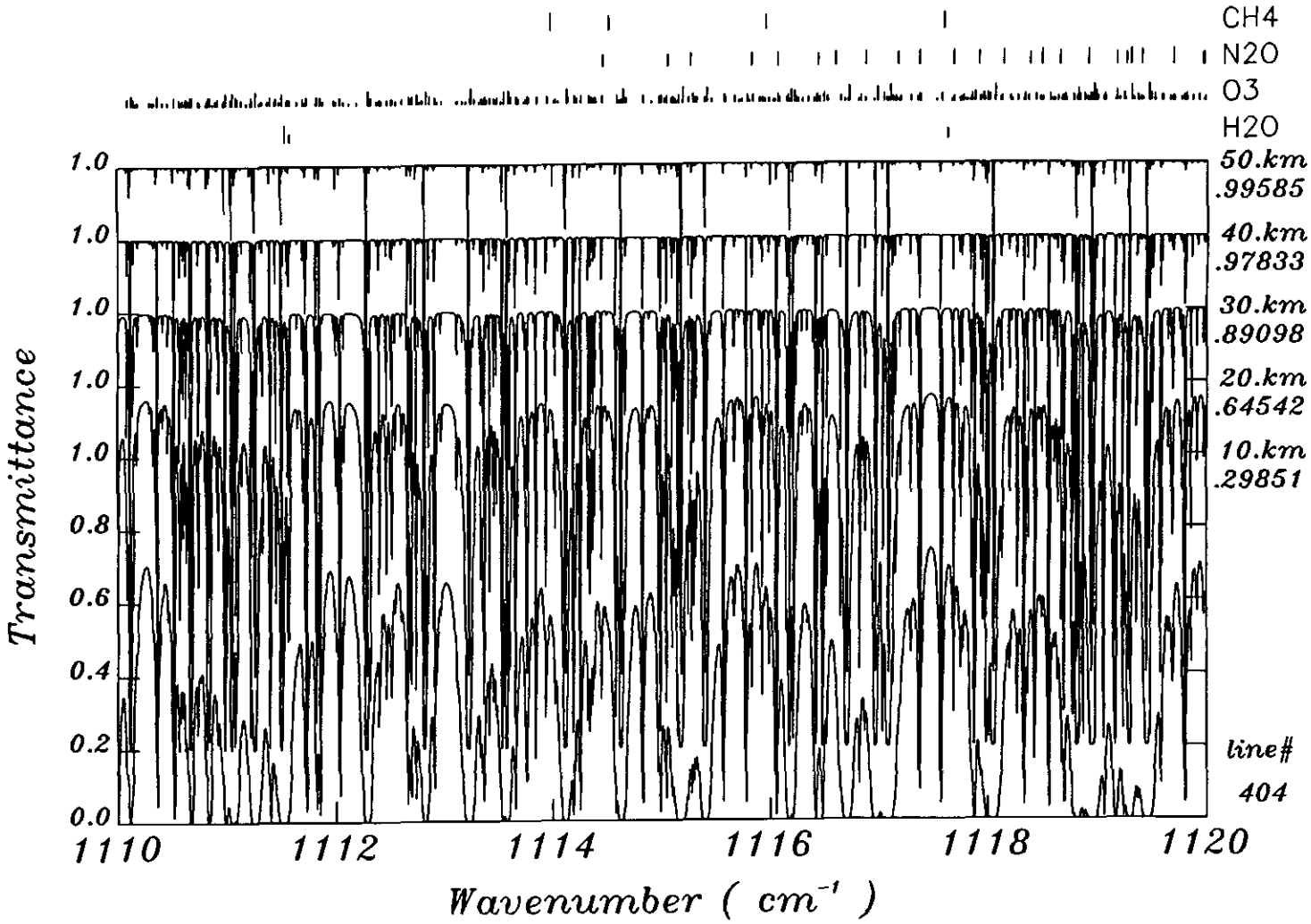

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
.98
1.0
.98
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
0.0
CFC12 (×25)
0.9840
CFC11 (×25)
0.9977
HNO3
1.0000
NO2
1.0000
CO2
0.9979
CH4
0.9999
N2O
1.0000
O3
0.6160
H2O
1.0000
1090
1092
1094
1096
1098
1100
Wavenumber (cm⁻¹)

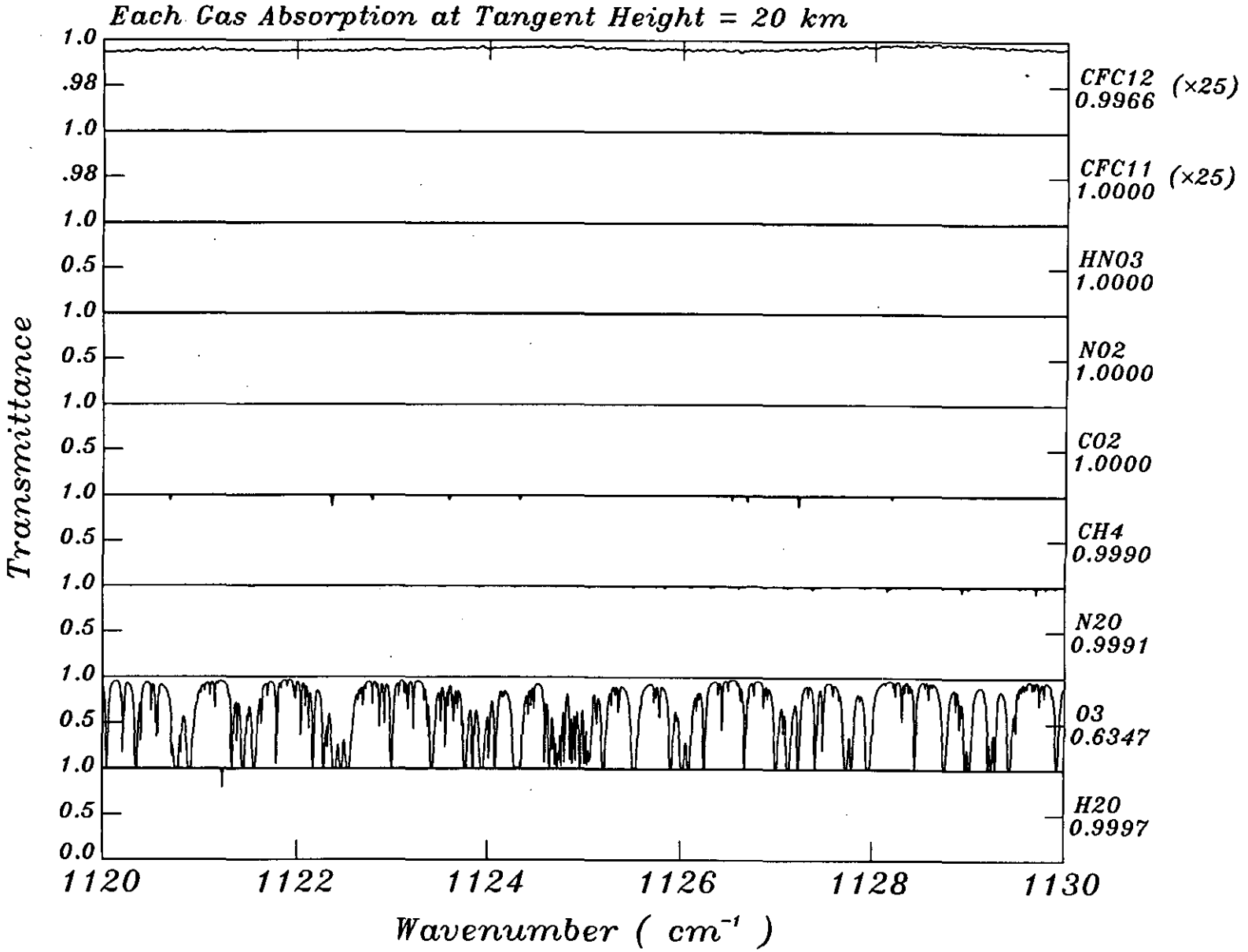

CO2
CH4
O3
H2O
50.km
.99530
40.km
.97175
30.km
.87643
20.km
.60349
10.km
.21409
line#
412
Transmittance
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
1090
1092
1094
1096
1098
1100
Wavenumber (cm⁻¹)

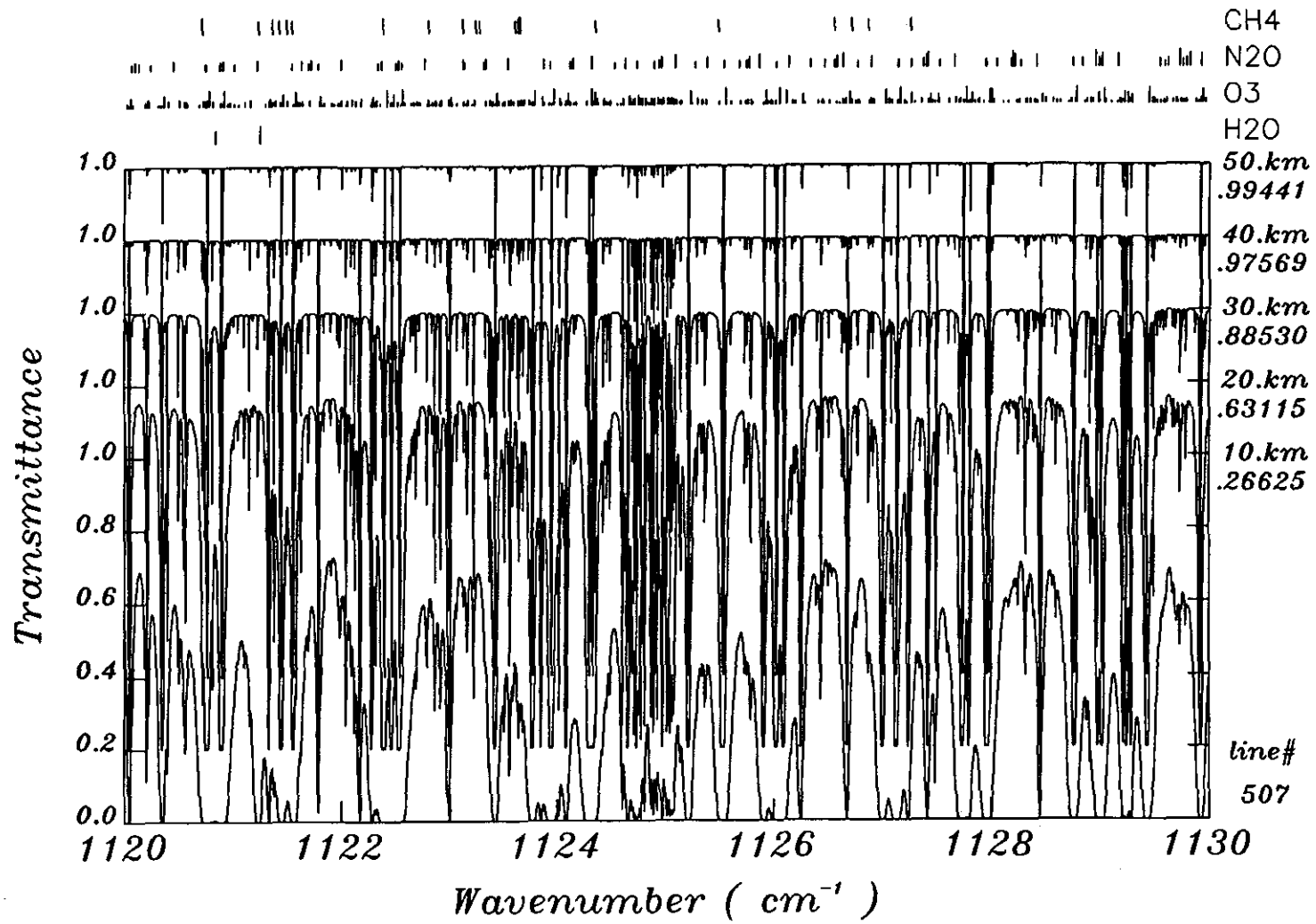

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
.98
1.0
.98
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
0.0
CFC12 (×25)
0.9819
CFC11 (×25)
1.0000
HN03
1.0000
N02
1.0000
C02
1.0000
CH4
0.9999
N20
1.0000
03
0.6789
H20
0.9997
1100
1102
1104
1106
1108
1110
Wavenumber (cm⁻¹)

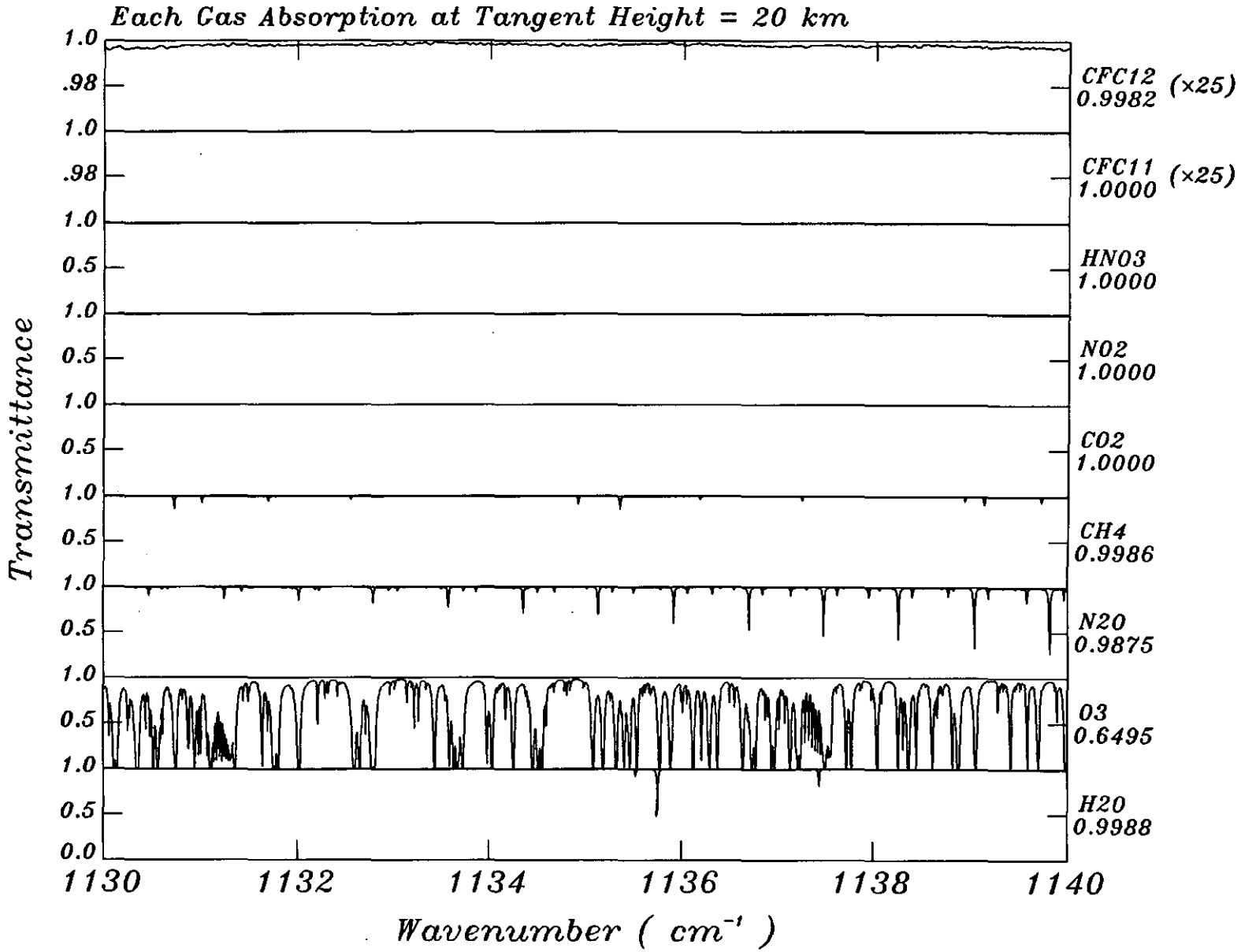

CO2
CH4
O3
H2O
50.km
.99633
40.km
.97777
30.km
.89715
20.km
.66632
10.km
.30477
line#
384
Transmittance
1.0
0.8
0.6
0.4
0.2
0.0
1100
1102
1104
1106
1108
1110
Wavenumber (cm⁻¹)

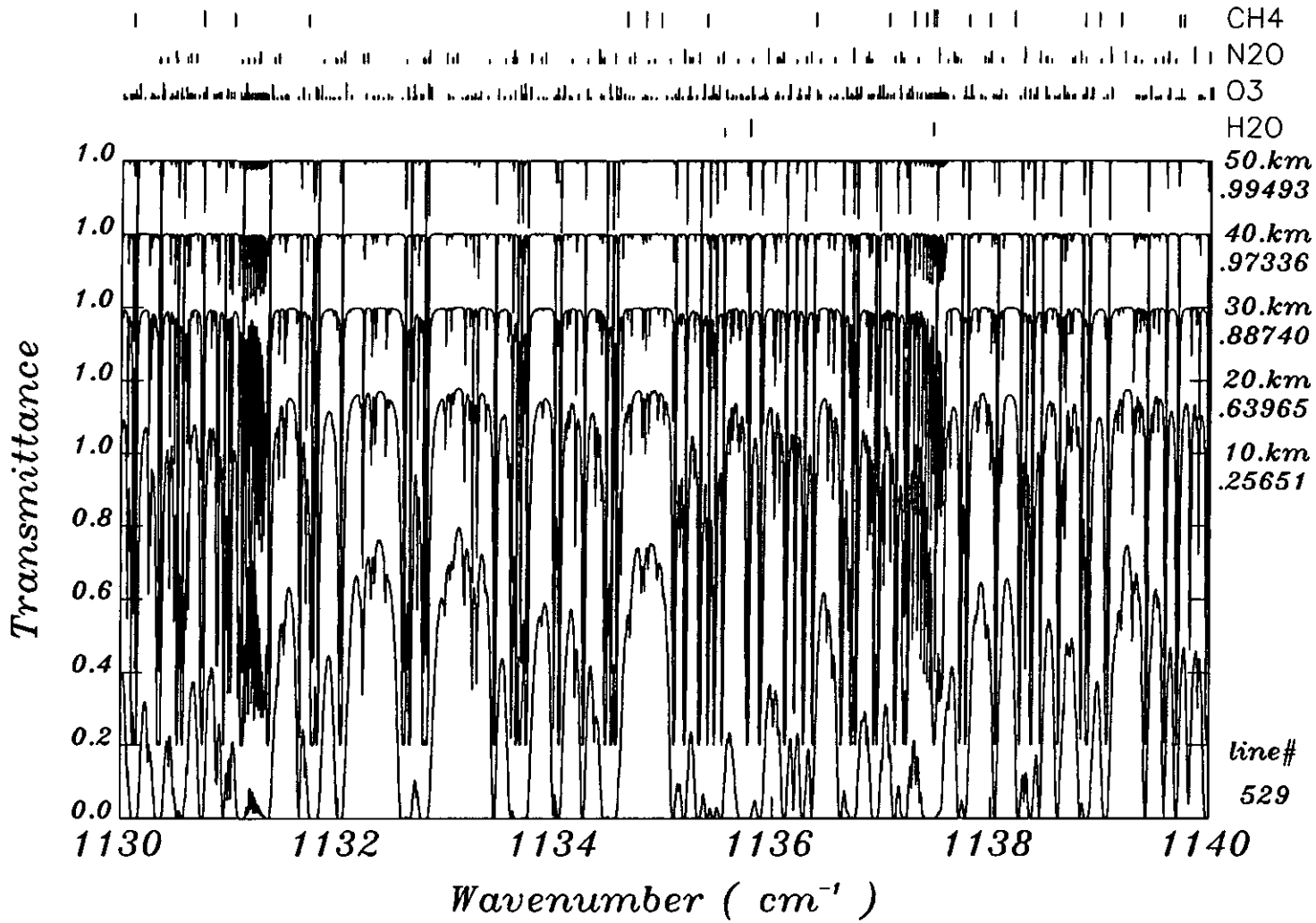

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
.98
1.0
.98
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
0.0
CFC12
0.9898
(×25)
CFC11
1.0000
(×25)
HNO3
1.0000
NO2
1.0000
CO2
1.0000
CH4
0.9996
N2O
1.0000
O3
0.6526
H2O
0.9997
1110
1112
1114
1116
1118
1120
Wavenumber (cm⁻¹)

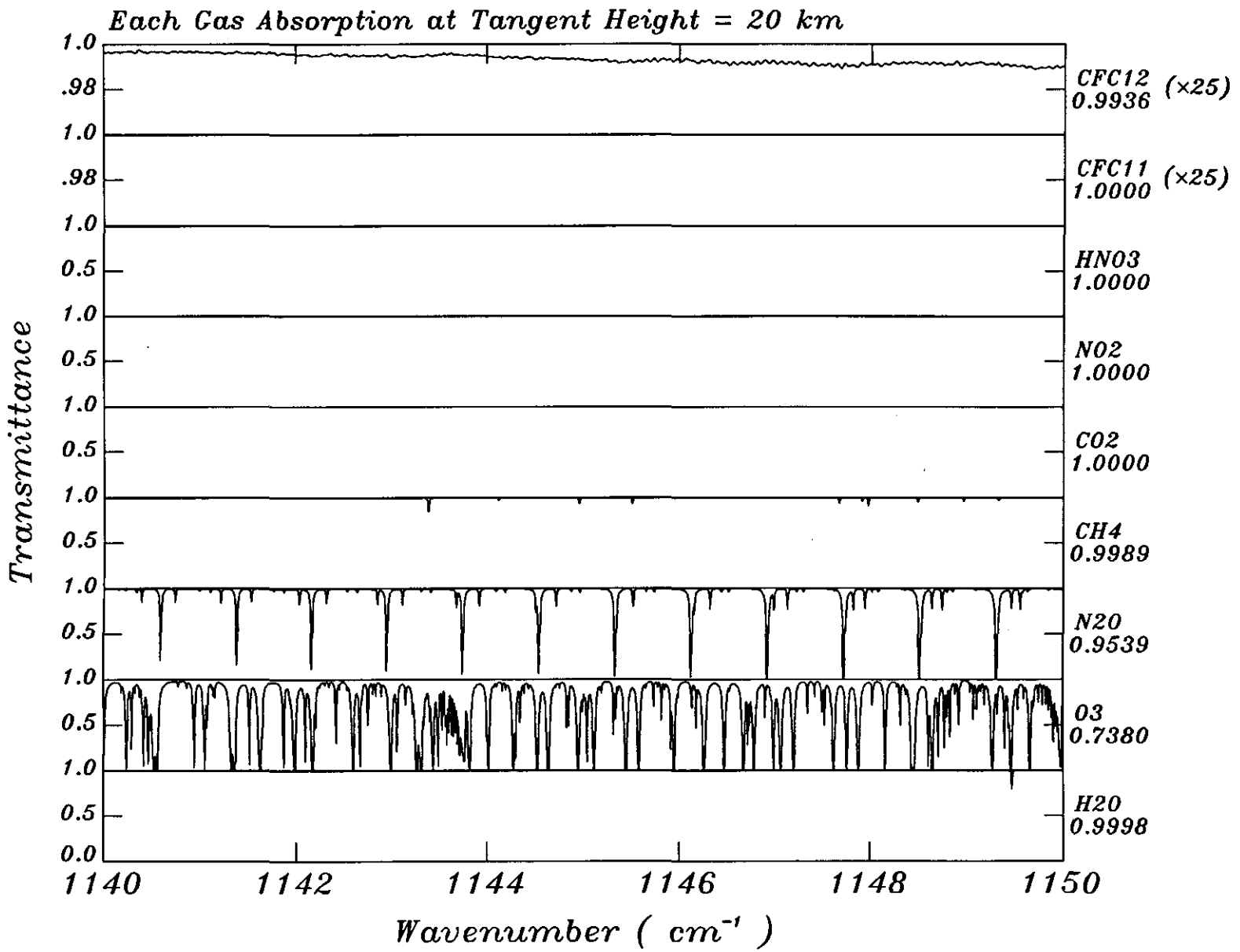

CH4
N2O
O3
H2O
50.km
.99585
40.km
.97833
30.km
.89098
20.km
.64542
10.km
.29851
line#
404
1.0
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
Transmittance
1110
1112
1114
1116
1118
1120
Wavenumber (cm⁻¹)

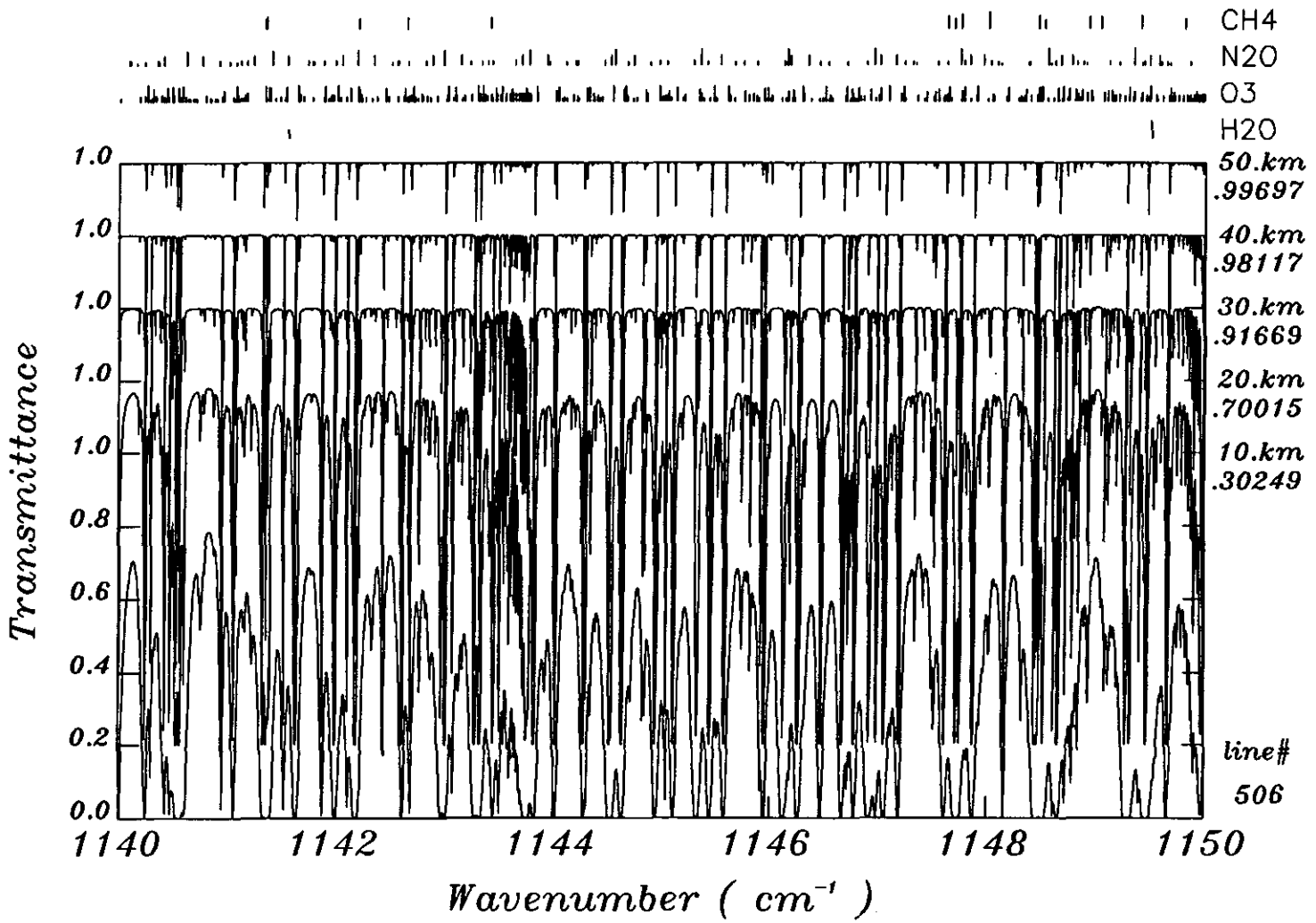

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
.98
1.0
.98
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
0.0
CFC12 (×25)
0.9966
CFC11 (×25)
1.0000
HN03
1.0000
N02
1.0000
C02
1.0000
CH4
0.9990
N20
0.9991
03
0.6347
H20
0.9997
1120
1122
1124
1126
1128
1130
Wavenumber (cm⁻¹)

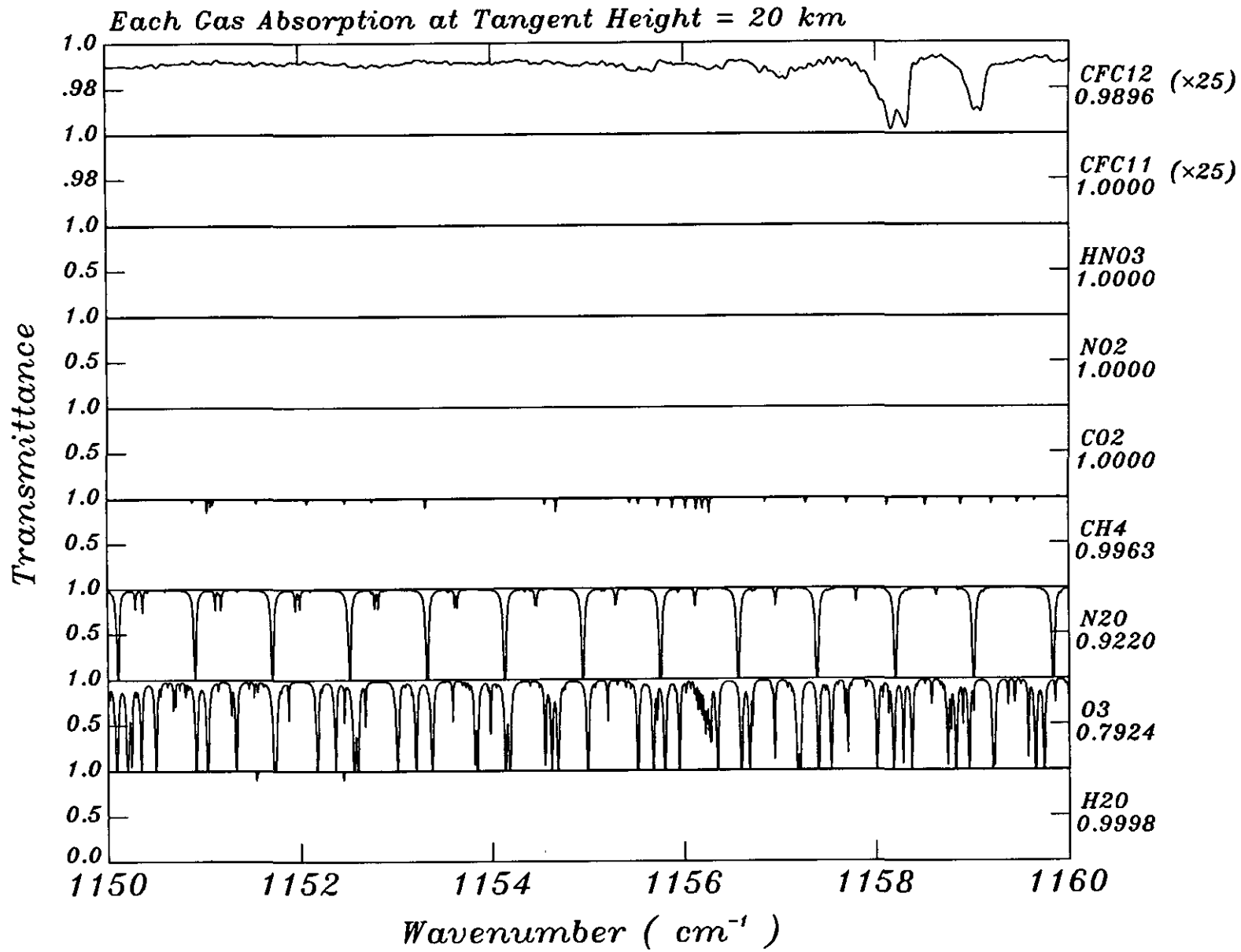

CH4
N2O
O3
H2O
50.km
.99441
40.km
.97569
30.km
.88530
20.km
.63115
10.km
.26625
line#
507
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
Transmittance
1120
1122
1124
1126
1128
1130
Wavenumber (cm⁻¹)

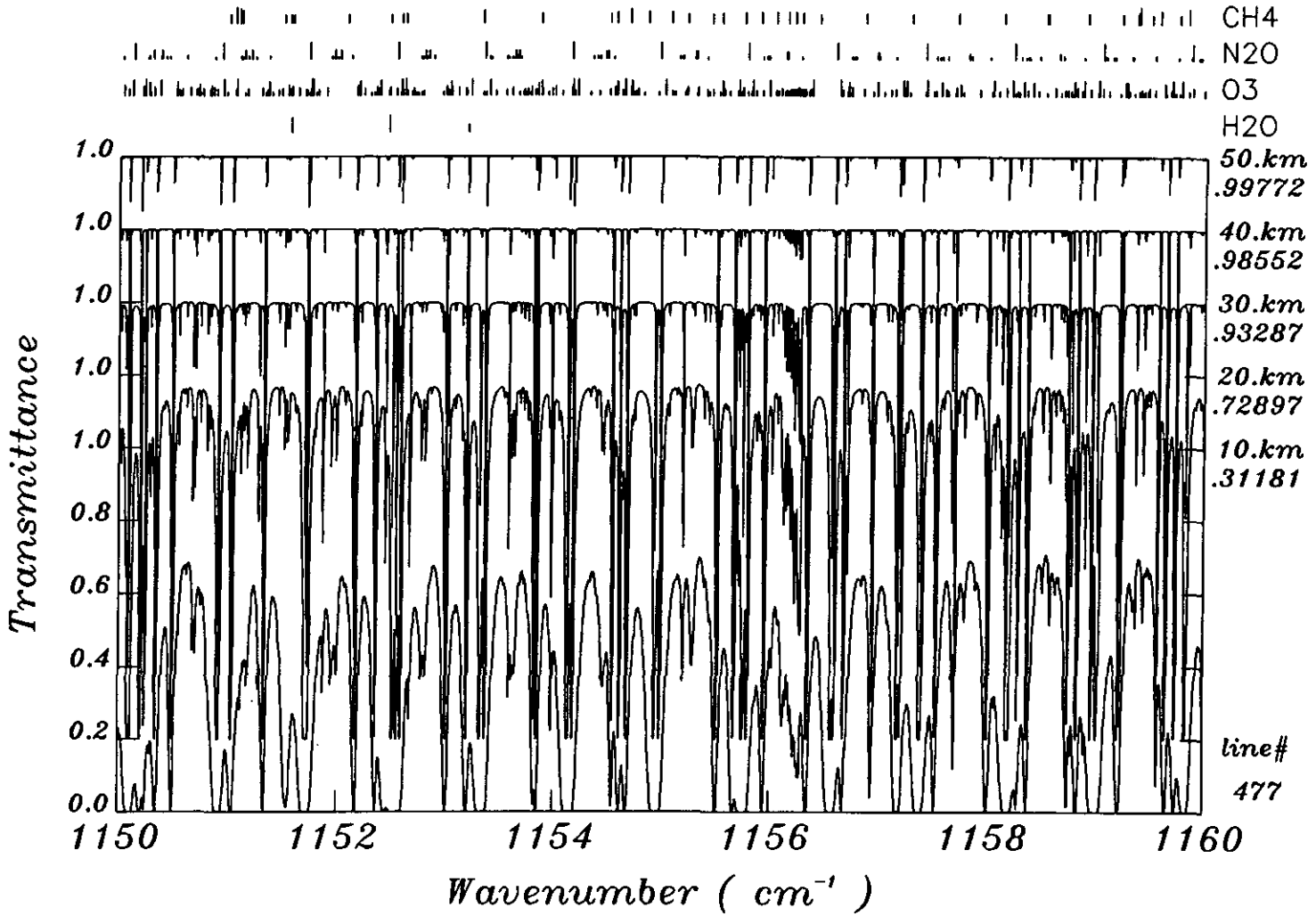

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
.98
1.0
.98
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
0.0
CFC12 (×25)
0.9982
CFC11 (×25)
1.0000
HN03
1.0000
N02
1.0000
C02
1.0000
CH4
0.9986
N20
0.9875
03
0.6495
H20
0.9988
1130
1132
1134
1136
1138
1140
Wavenumber (cm⁻¹)

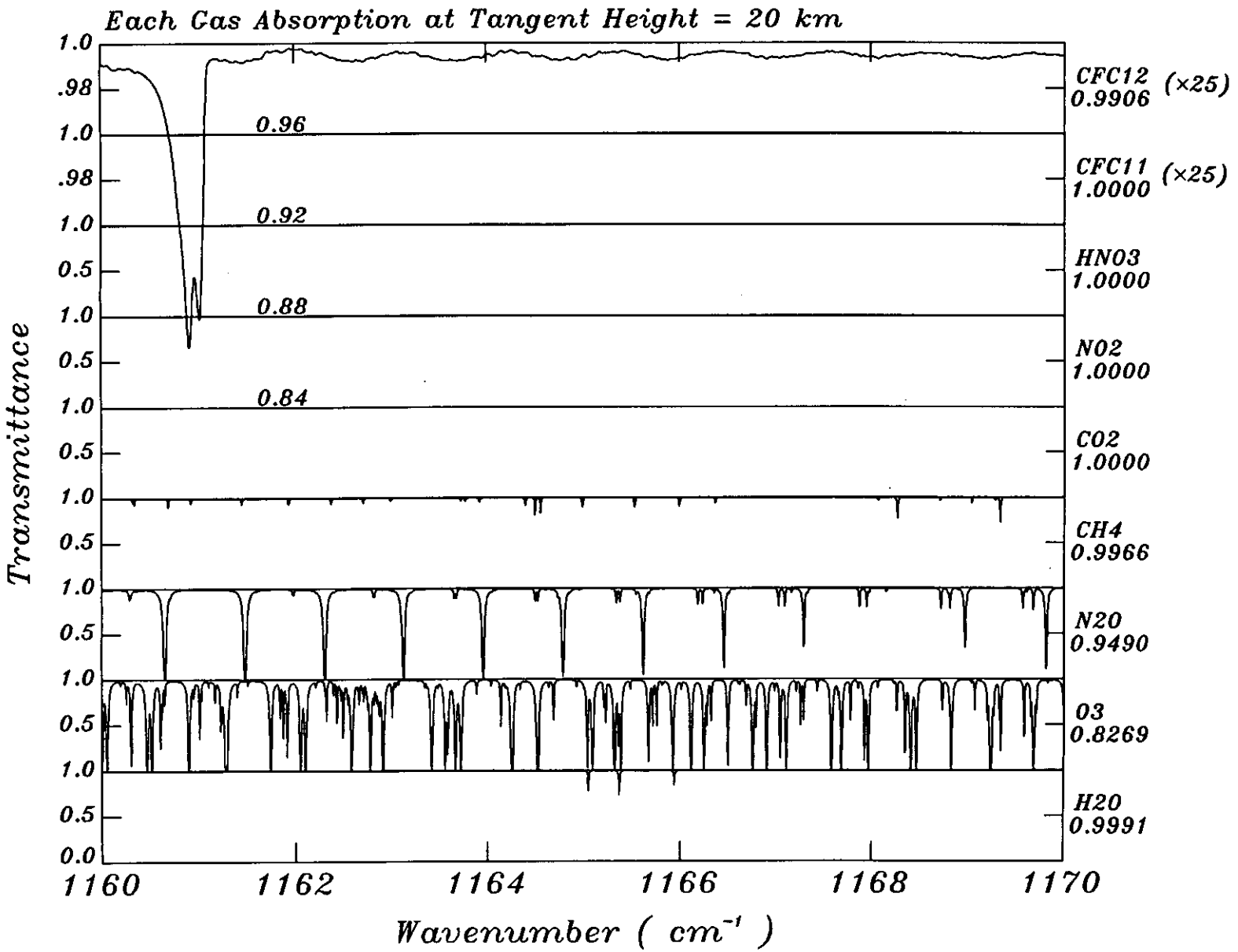

CH4
N2O
O3
H2O
50.km
.99493
40.km
.97336
30.km
.88740
20.km
.63965
10.km
.25651
line#
529
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
Transmittance
1130
1132
1134
1136
1138
1140
Wavenumber (cm⁻¹)

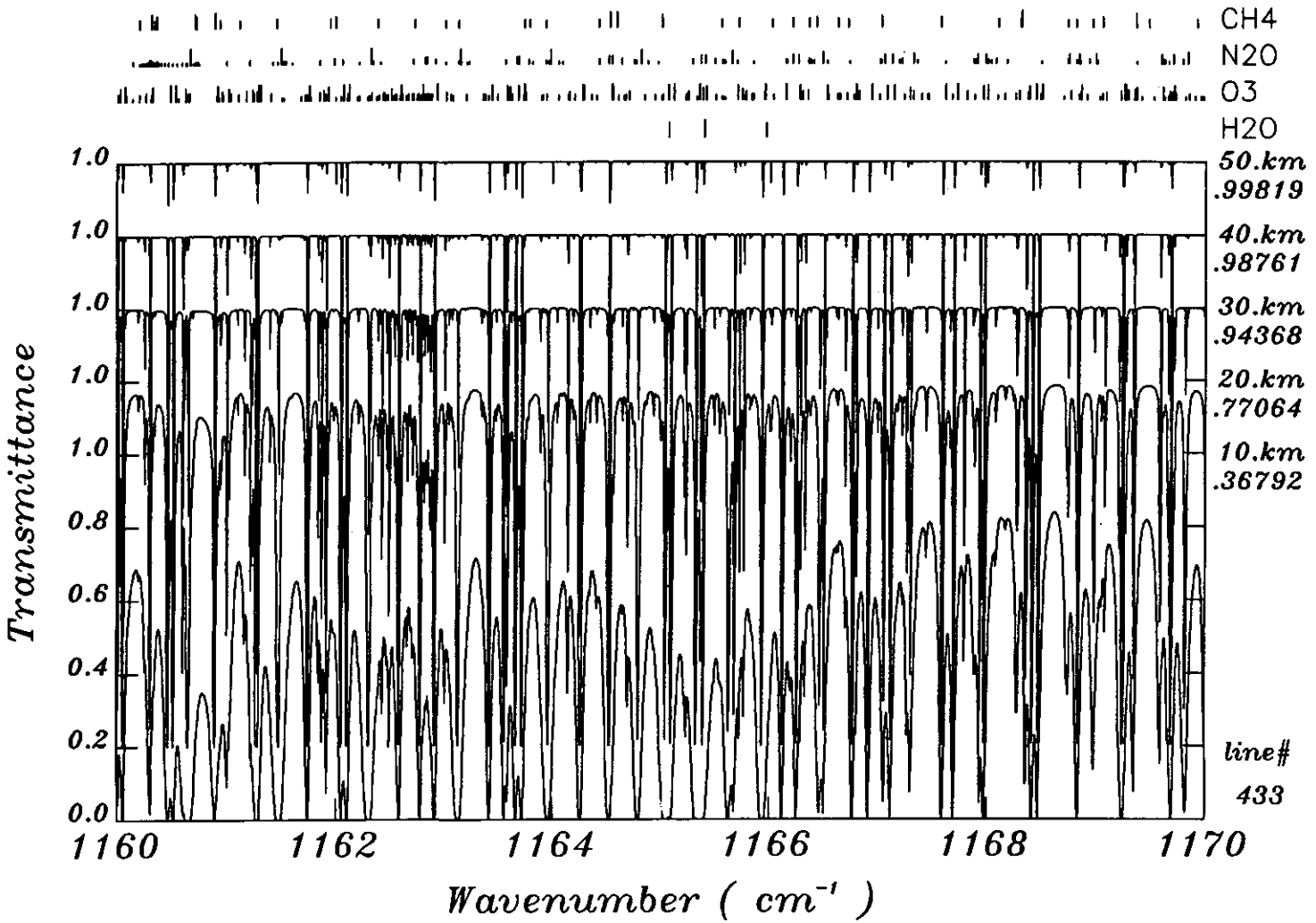

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
.98
1.0
.98
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
0.0
CFC12 (×25)
0.9936
CFC11 (×25)
1.0000
HN03
1.0000
N02
1.0000
C02
1.0000
CH4
0.9989
N20
0.9539
03
0.7380
H20
0.9998
1140
1142
1144
1146
1148
1150
Wavenumber (cm⁻¹)

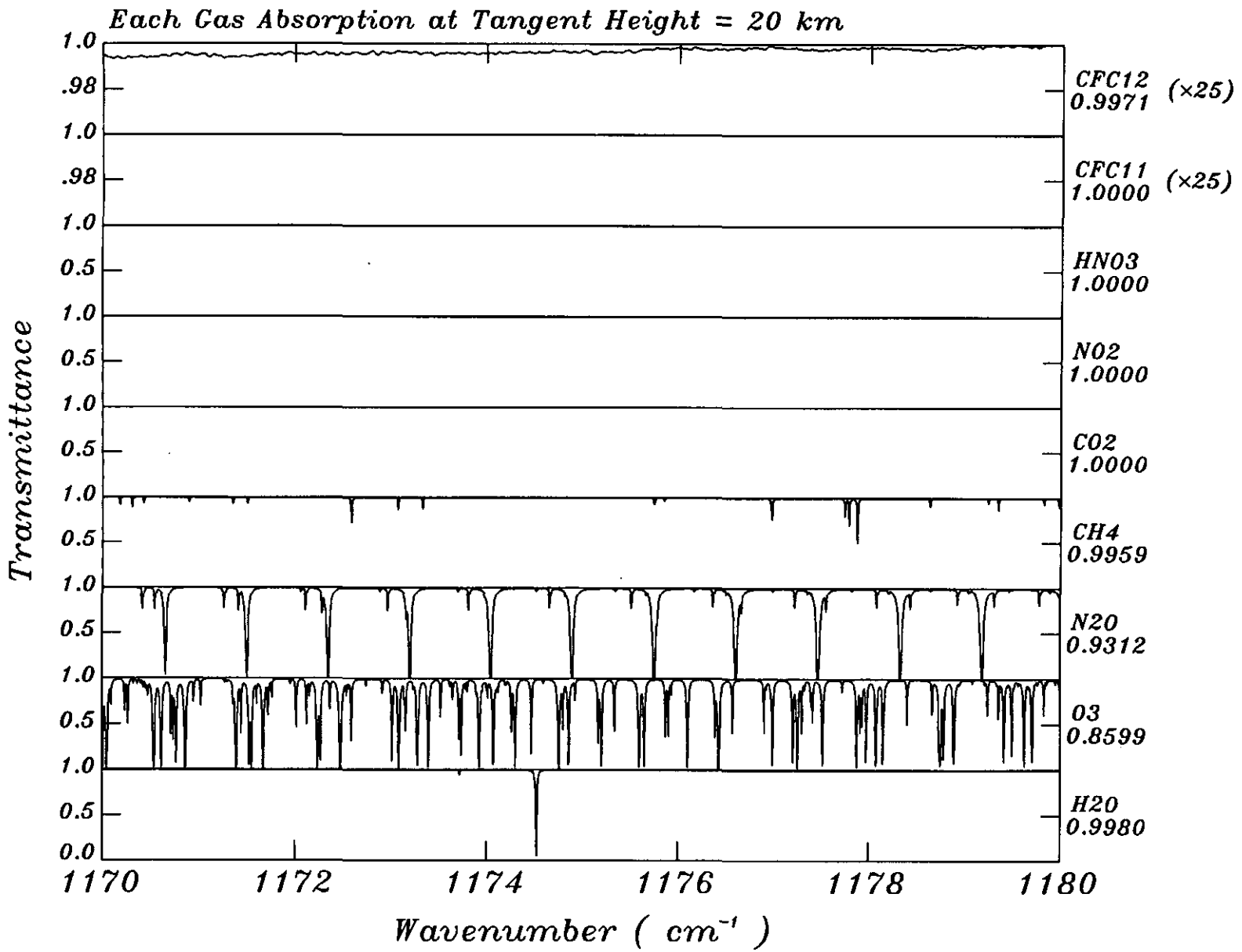

CH4
N2O
O3
H2O
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
Transmittance
50.km
.99697
40.km
.98117
30.km
.91669
20.km
.70015
10.km
.30249
line#
506
1140
1142
1144
1146
1148
1150
Wavenumber (cm⁻¹)

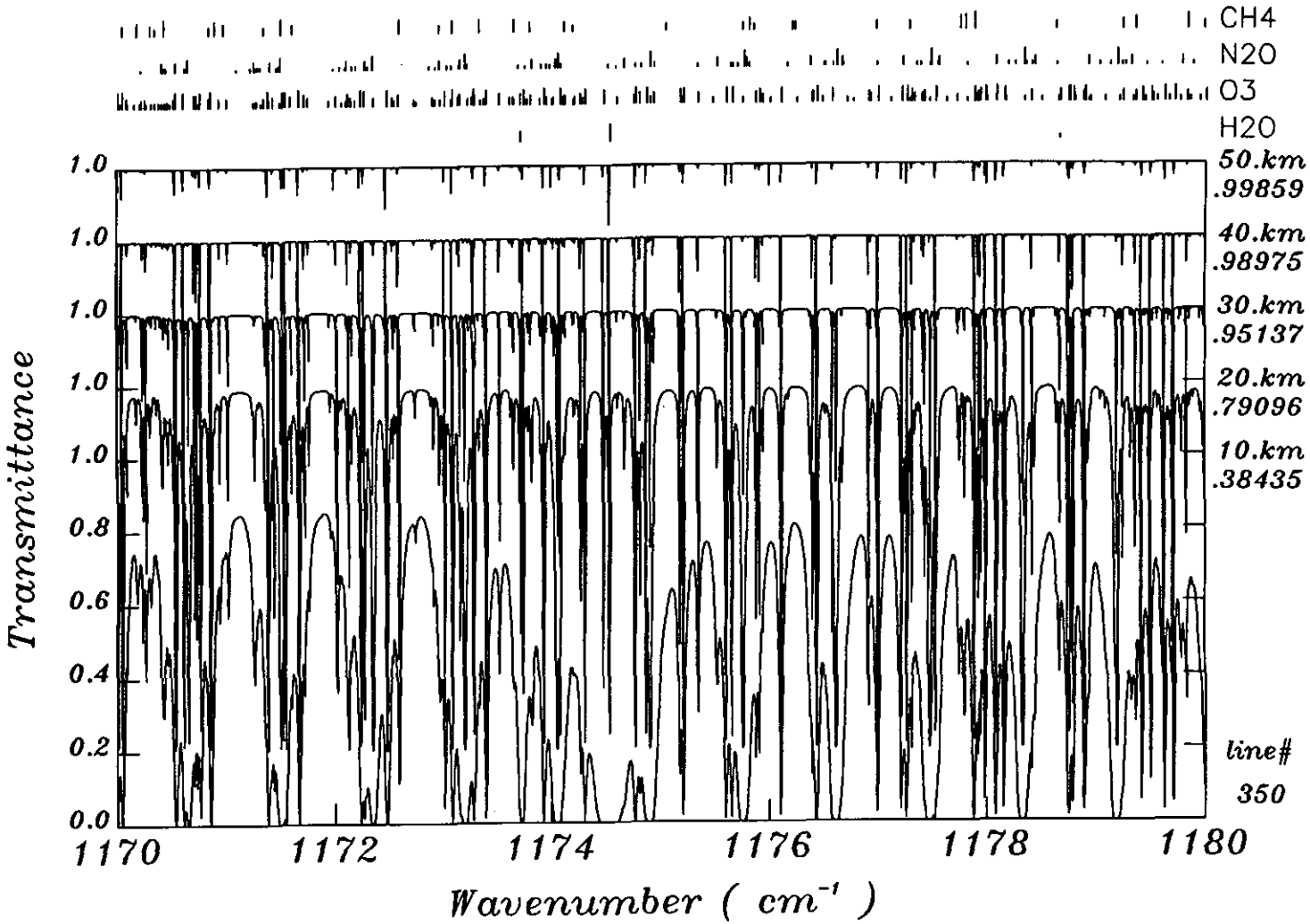

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
.98
1.0
.98
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
0.0
CFC12 (×25)
0.9896
CFC11 (×25)
1.0000
HNO3
1.0000
NO2
1.0000
CO2
1.0000
CH4
0.9963
N2O
0.9220
O3
0.7924
H2O
0.9998
1150
1152
1154
1156
1158
1160
Wavenumber (cm⁻¹)

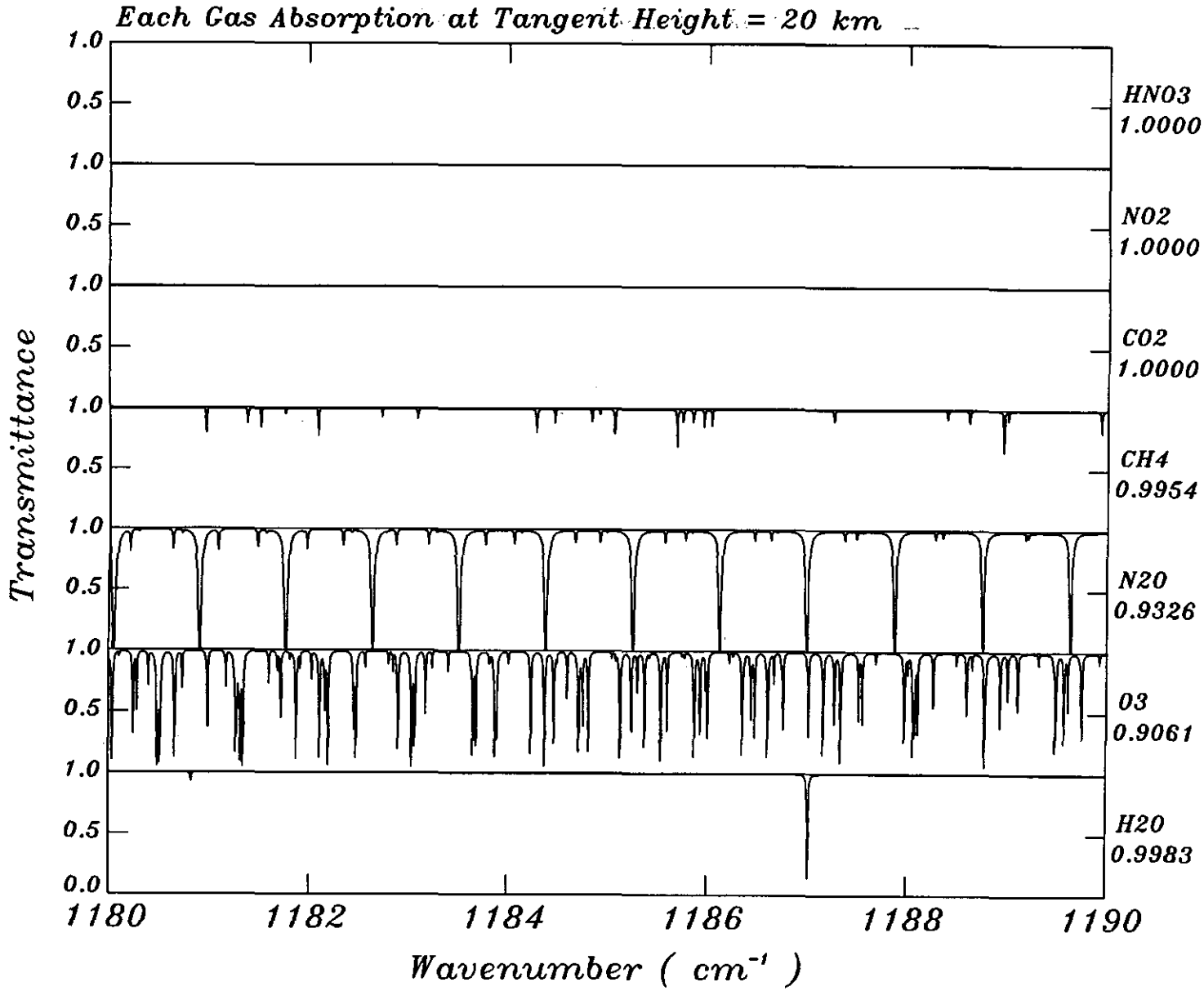

CH4
N2O
O3
H2O
50.km
.99772
40.km
.98552
30.km
.93287
20.km
.72897
10.km
.31181
line#
477
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
Transmittance
1150
1152
1154
1156
1158
1160
Wavenumber (cm⁻¹)

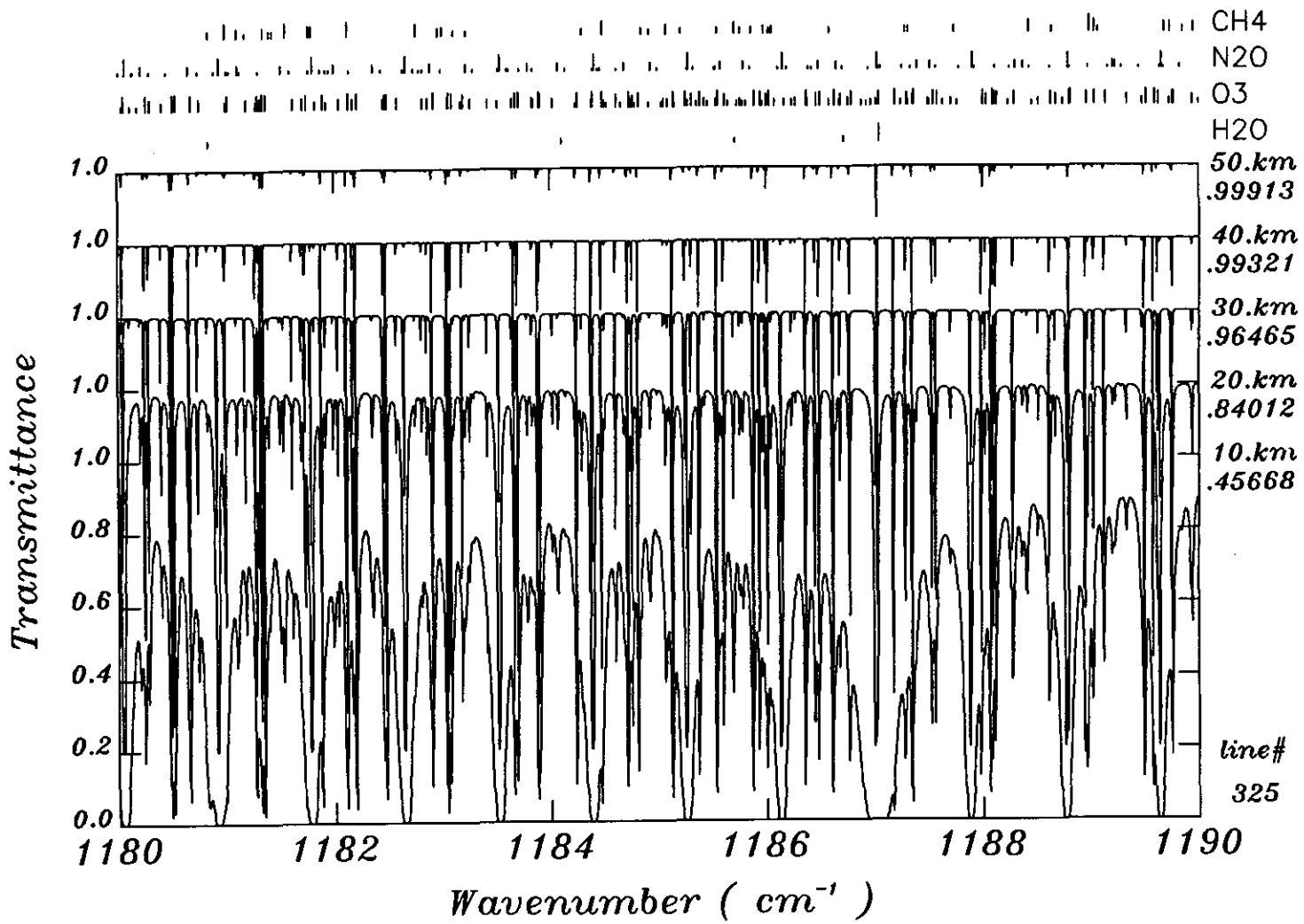

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
.98
0.96
1.0
.98
0.92
1.0
0.5
0.88
1.0
0.5
0.84
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
0.0
CFC12 (×25)
0.9906
CFC11 (×25)
1.0000
HN03
1.0000
N02
1.0000
C02
1.0000
CH4
0.9966
N20
0.9490
03
0.8269
H20
0.9991
1160
1162
1164
1166
1168
1170
Wavenumber (cm⁻¹)

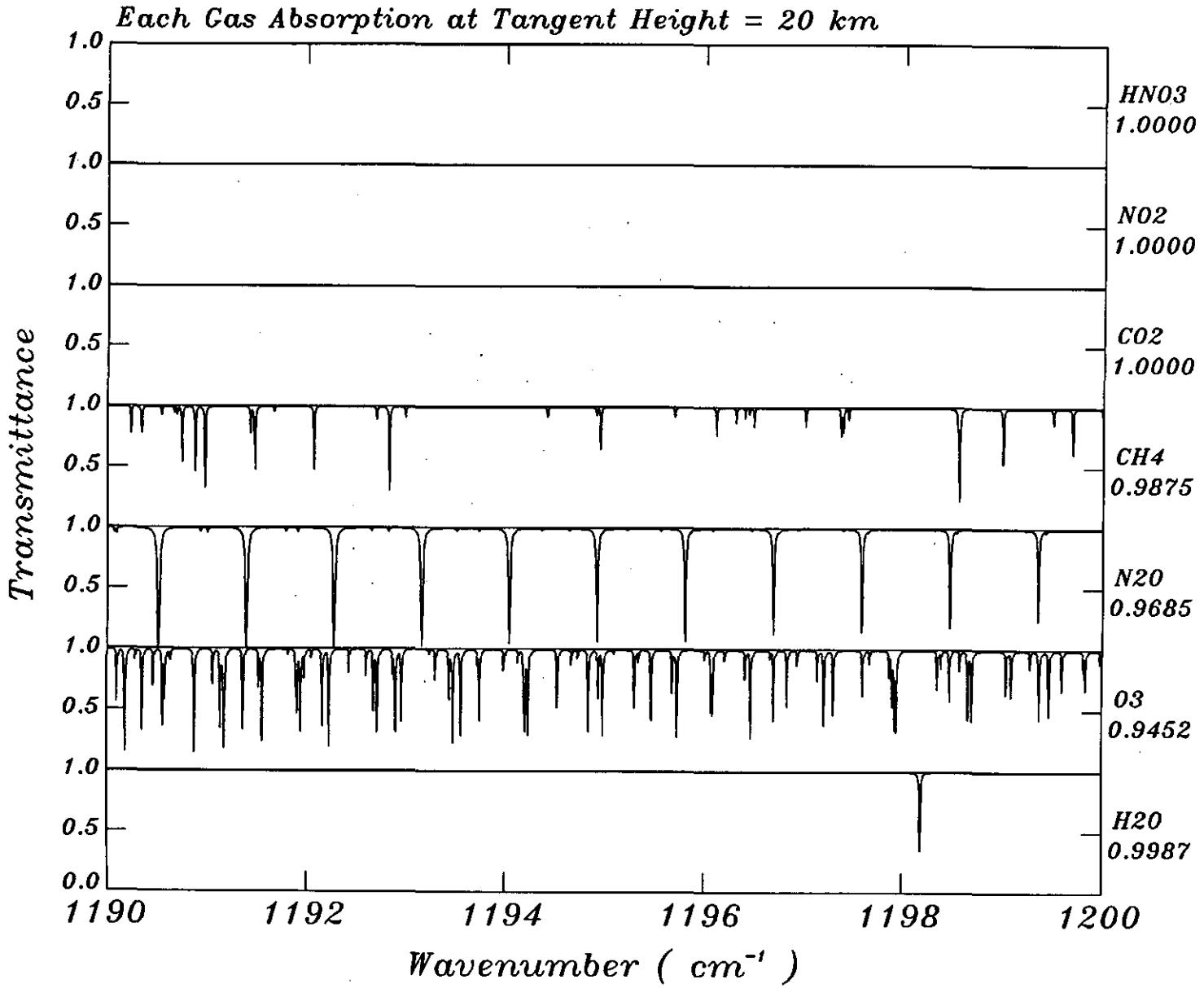

CH4
N2O
O3
H2O
50.km
.99819
40.km
.98761
30.km
.94368
20.km
.77064
10.km
.36792
line#
433
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
Transmittance
1160
1162
1164
1166
1168
1170
Wavenumber (cm⁻¹)

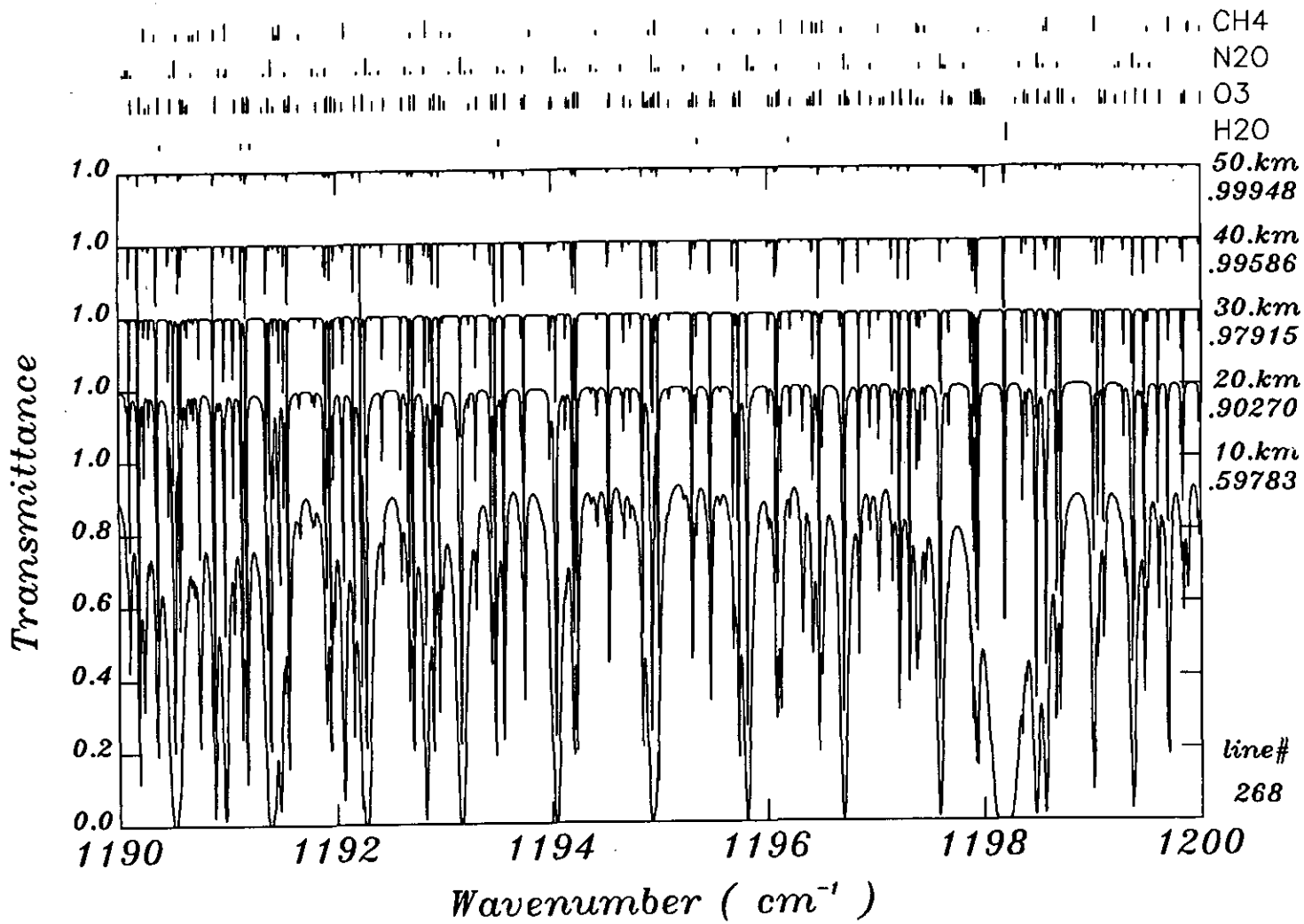

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
.98
1.0
.98
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
0.0
CFC12
0.9971
(×25)
CFC11
1.0000
(×25)
HN03
1.0000
N02
1.0000
C02
1.0000
CH4
0.9959
N20
0.9312
03
0.8599
H20
0.9980
1170
1172
1174
1176
1178
1180
Wavenumber (cm⁻¹)

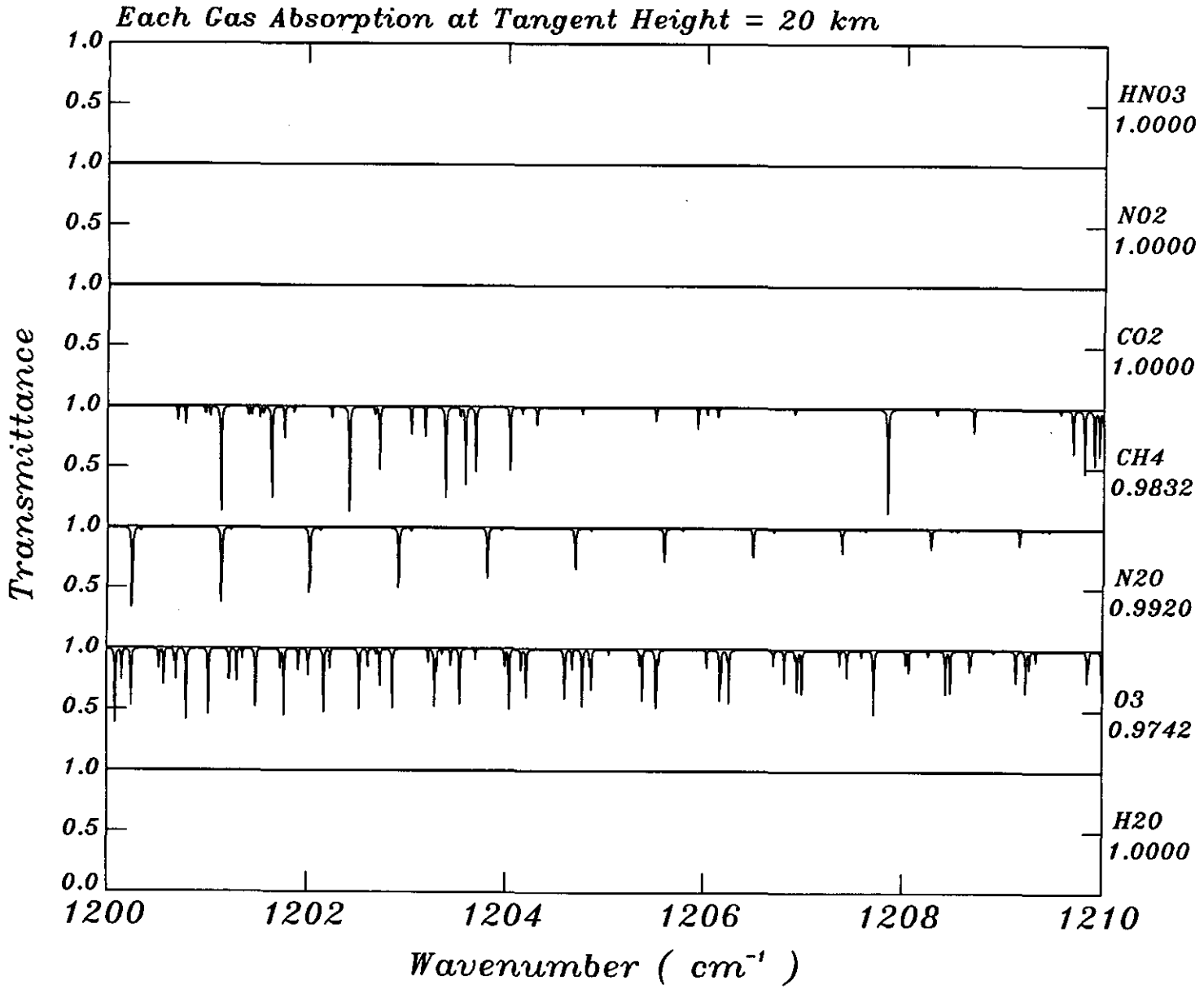

CH4
N2O
O3
H2O
50.km
.99859
40.km
.98975
30.km
.95137
20.km
.79096
10.km
.38435
line#
350
Transmittance
1.0
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
1170
1172
1174
1176
1178
1180
Wavenumber (cm⁻¹)

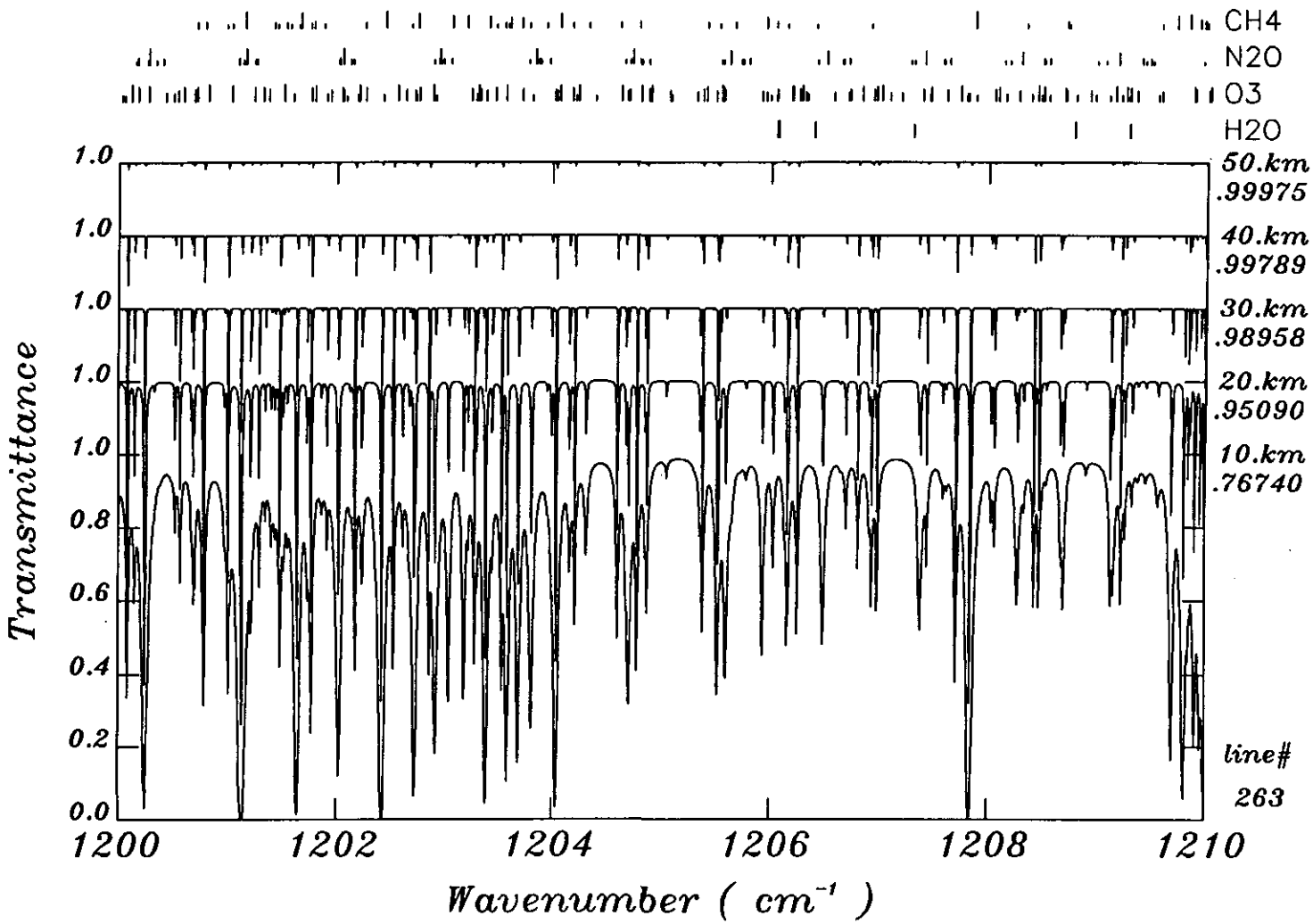

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
0.5
0.0
HNO3
1.0000
NO2
1.0000
CO2
1.0000
CH4
0.9954
N2O
0.9326
O3
0.9061
H2O
0.9983
1180
1182
1184
1186
1188
1190
Wavenumber (cm-1)

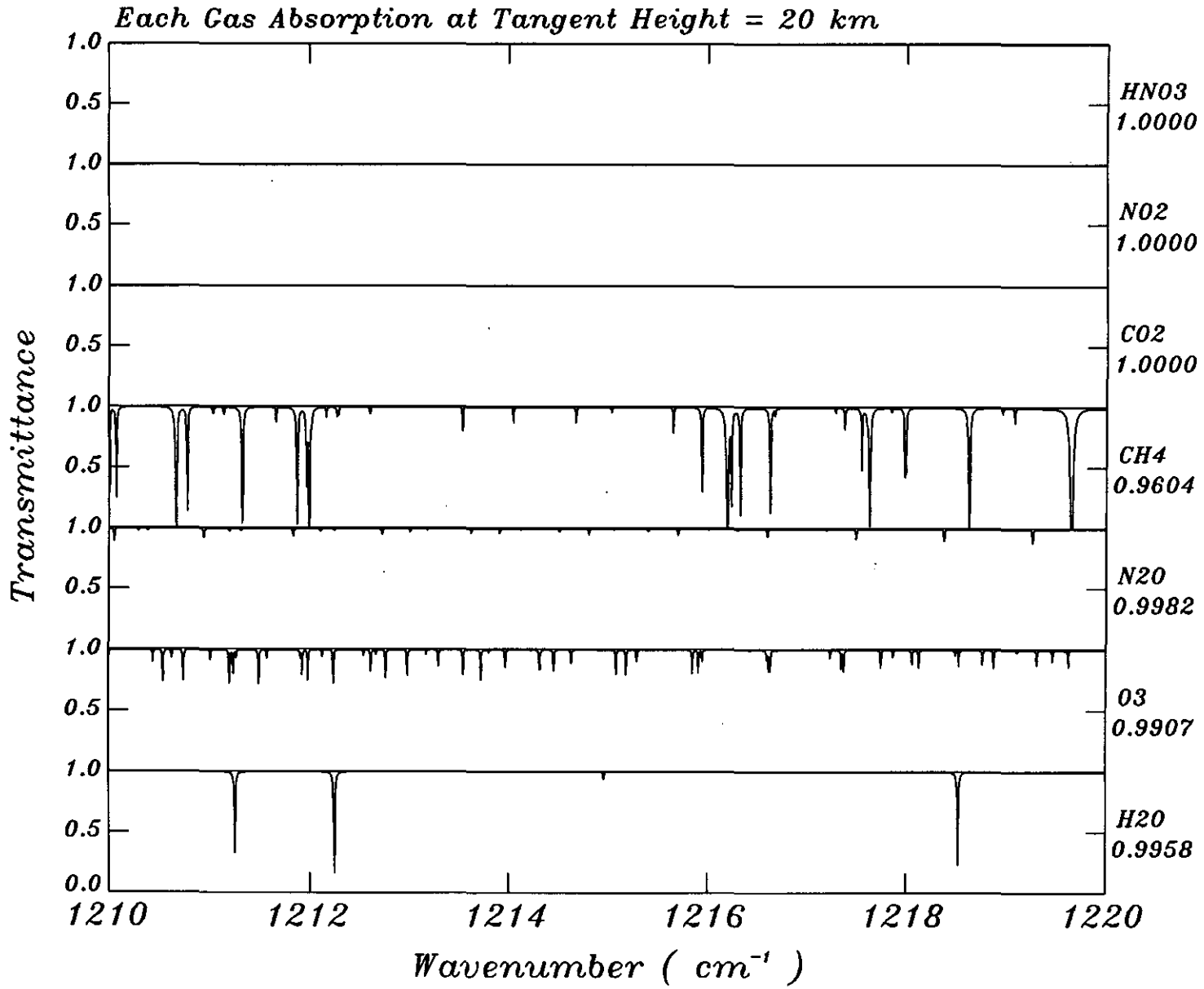

CH4
N2O
O3
H2O
50.km
.99913
40.km
.99321
30.km
.96465
20.km
.84012
10.km
.45668
line#
325
1.0
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
Transmittance
1180
1182
1184
1186
1188
1190
Wavenumber (cm⁻¹)

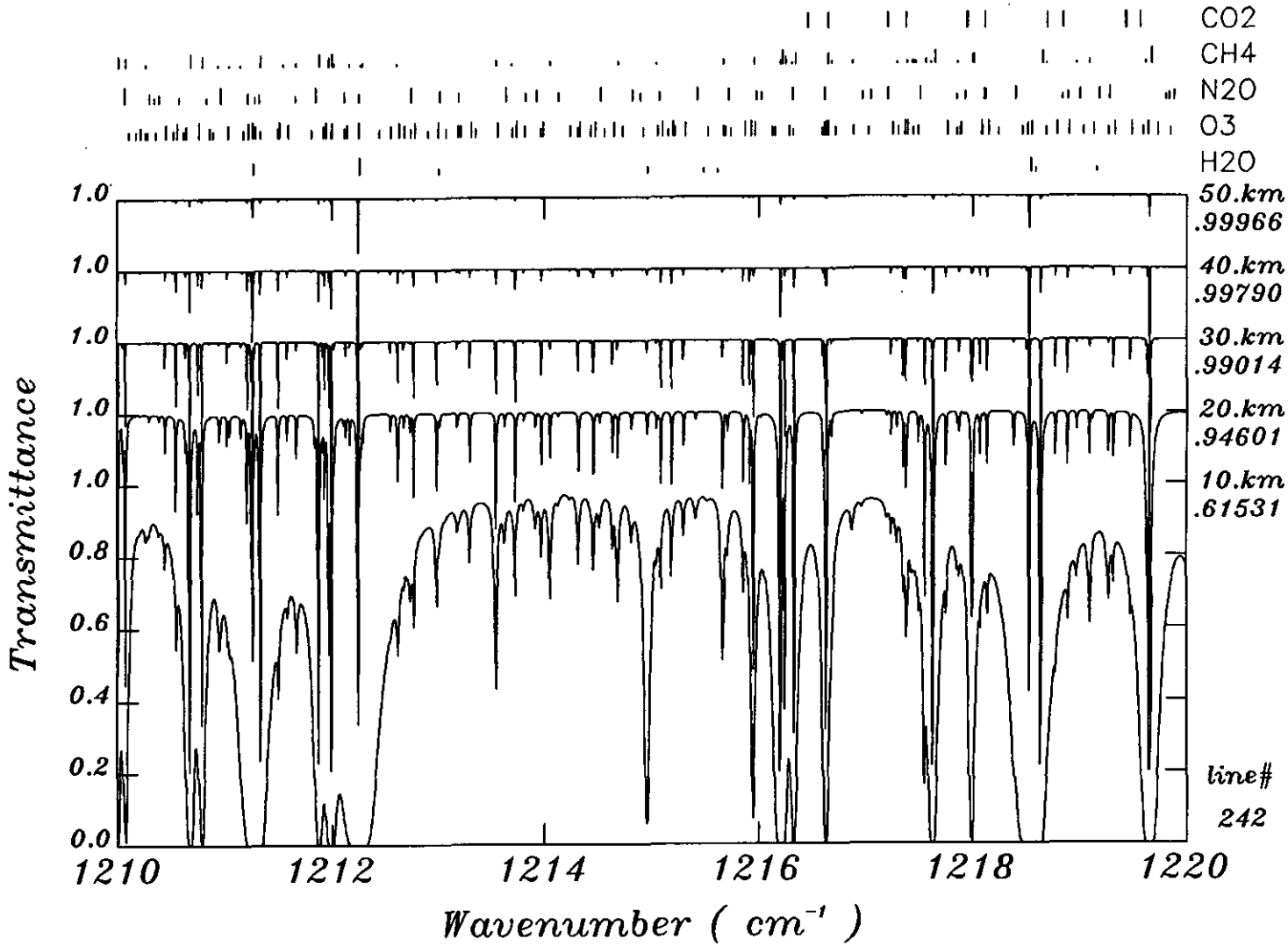

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
0.5
0.0
HN03
1.0000
NO2
1.0000
CO2
1.0000
CH4
0.9875
N20
0.9685
03
0.9452
H20
0.9987
1190
1192
1194
1196
1198
1200
Wavenumber (cm-1)

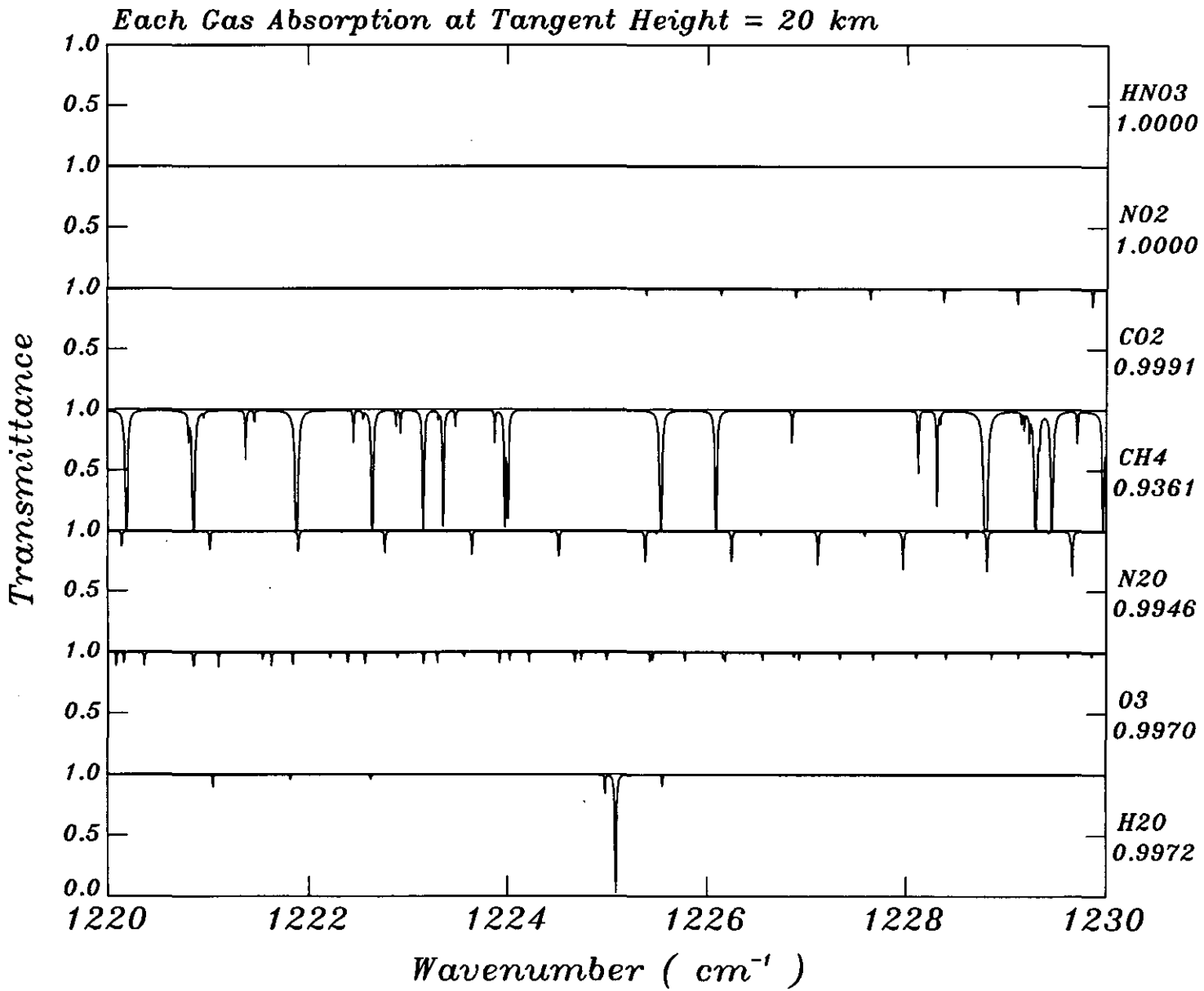

CH4
N2O
O3
H2O
50.km
.99948
40.km
.99586
30.km
.97915
20.km
.90270
10.km
.59783
line#
268
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
Transmittance
1190
1192
1194
1196
1198
1200
Wavenumber (cm⁻¹)

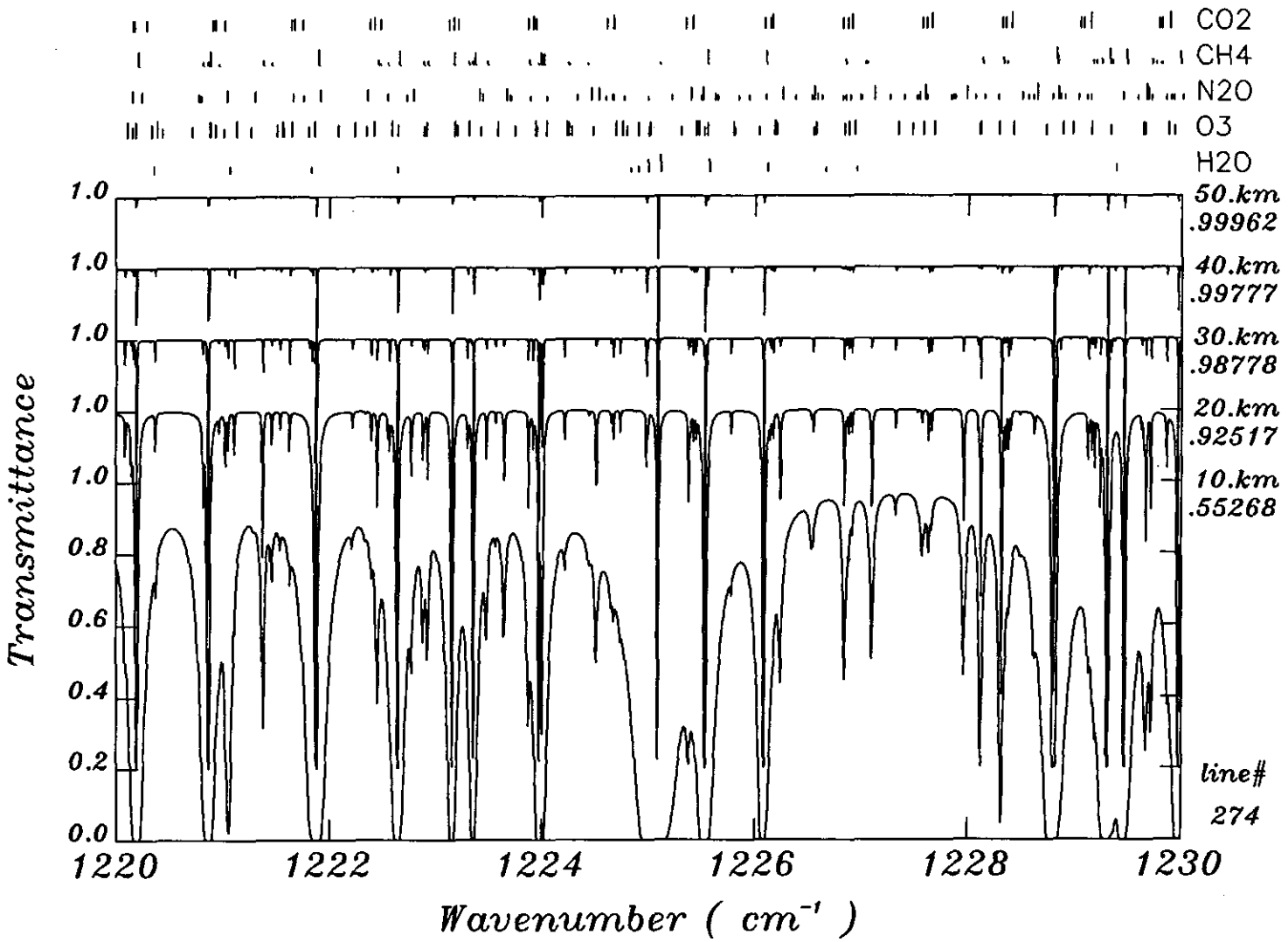

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
0.5
0.0
HN03
1.0000
NO2
1.0000
CO2
1.0000
CH4
0.9832
N20
0.9920
03
0.9742
H20
1.0000
1200
1202
1204
1206
1208
1210
Wavenumber (cm-1)

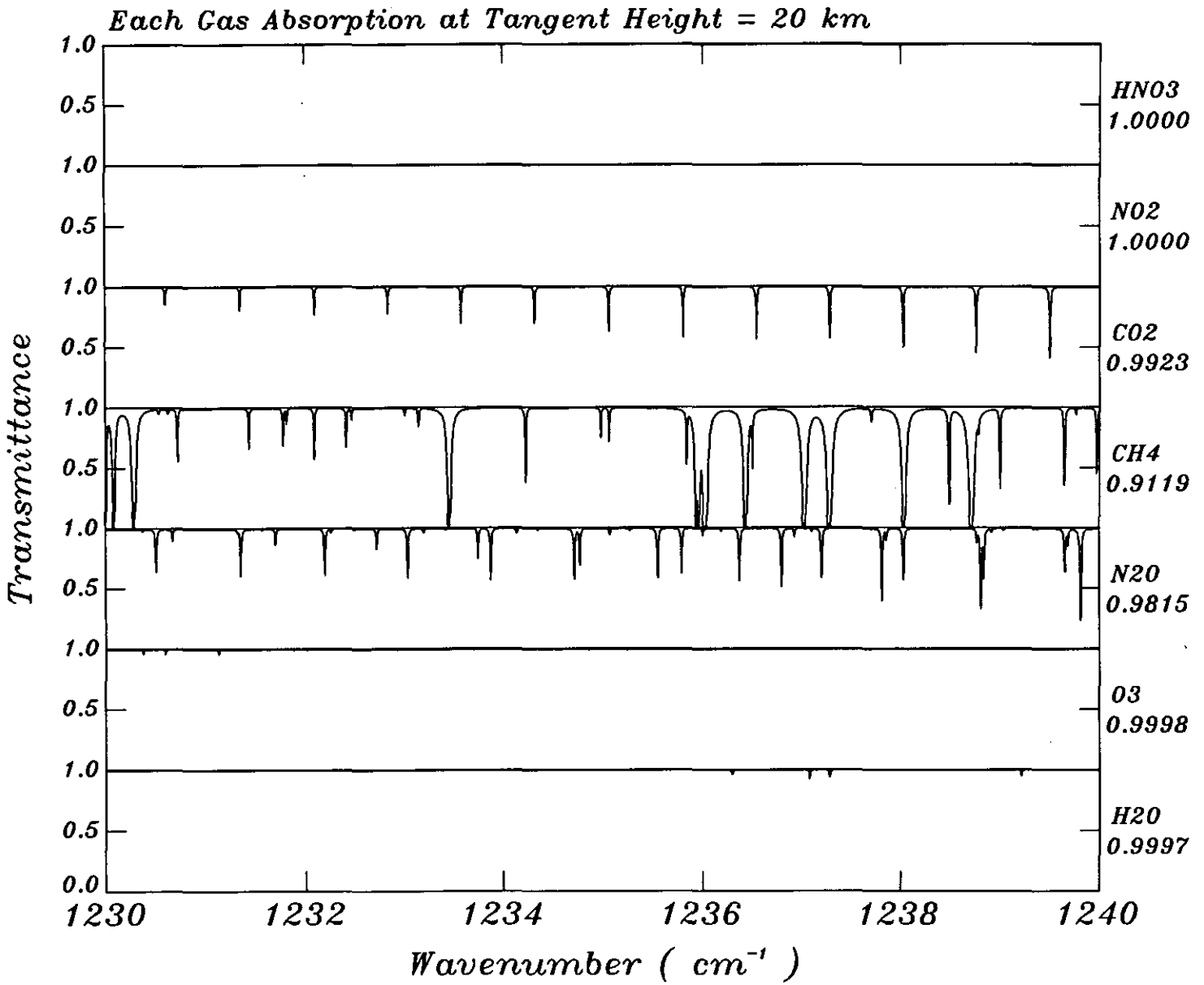

CH4
N2O
O3
H2O
50.km
.99975
40.km
.99789
30.km
.98958
20.km
.95090
10.km
.76740
line#
263
1.0
0.8
0.6
0.4
0.2
0.0
Transmittance
1200
1202
1204
1206
1208
1210
Wavenumber (cm⁻¹)

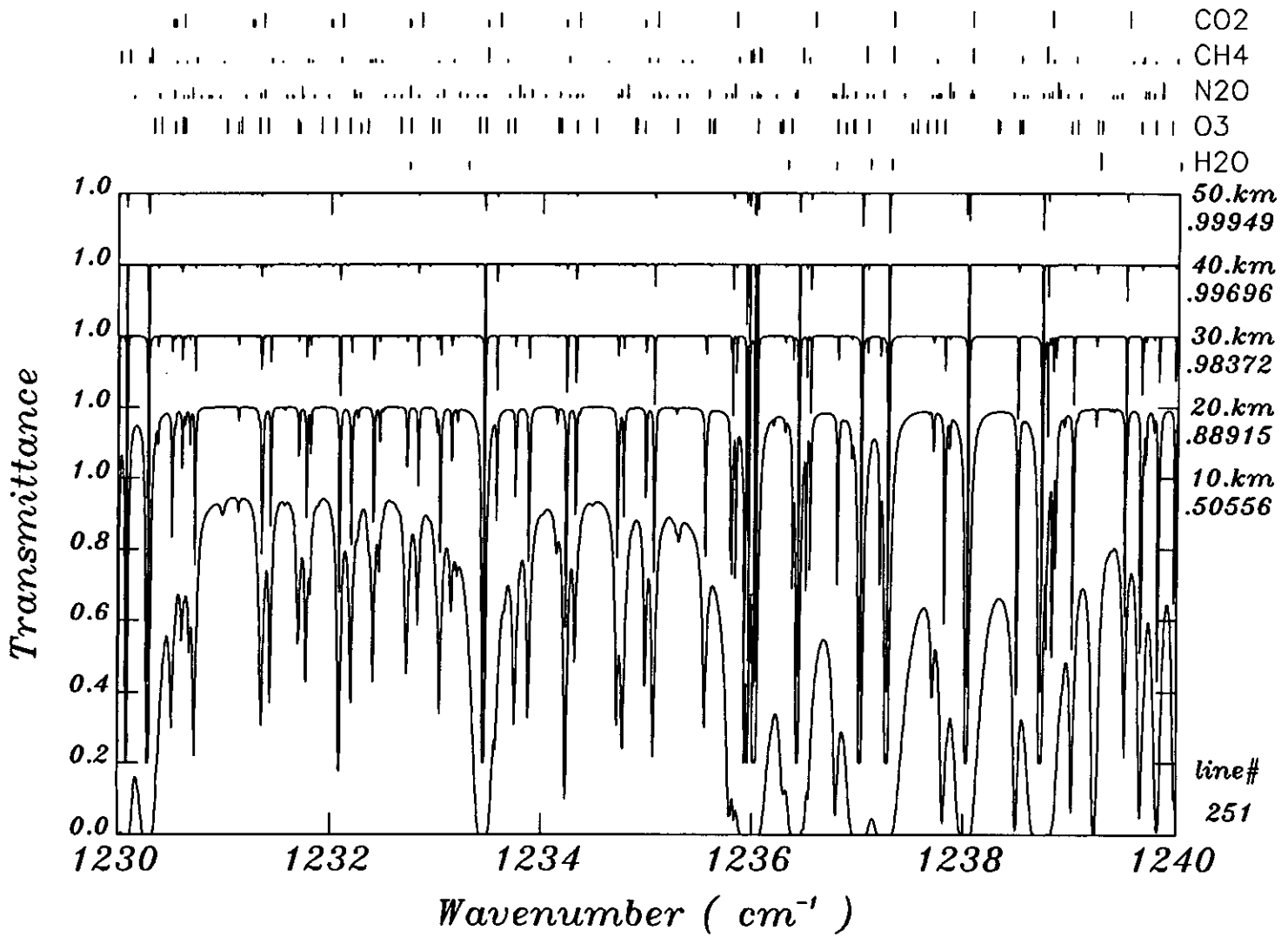

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
0.5
0.0
HN03
1.0000
NO2
1.0000
CO2
1.0000
CH4
0.9604
N20
0.9982
03
0.9907
H20
0.9958
1210
1212
1214
1216
1218
1220
Wavenumber (cm⁻¹)

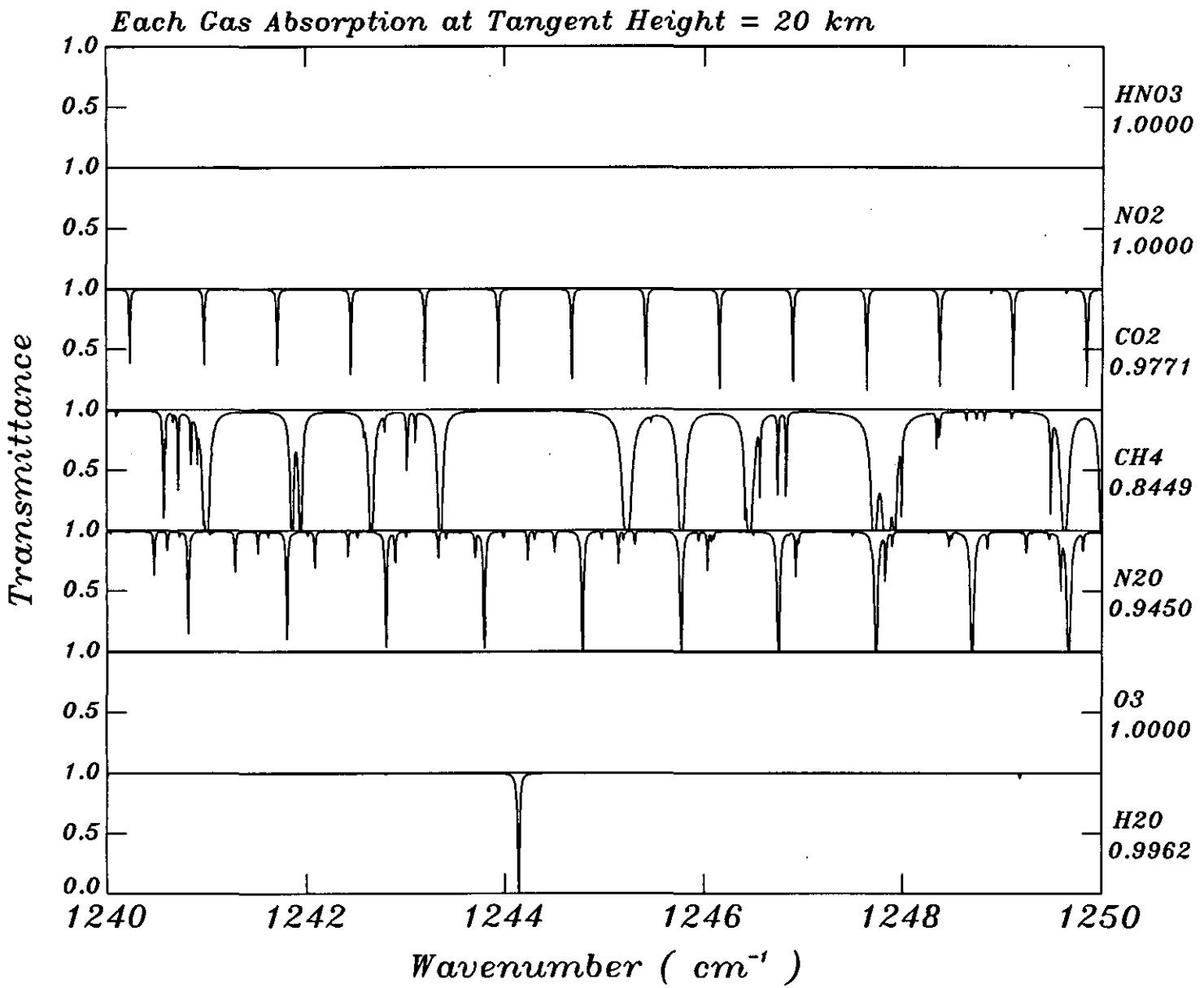

CO2
CH4
N2O
O3
H2O
50.km
.99966
40.km
.99790
30.km
.99014
20.km
.94601
10.km
.61531
line#
242
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
Transmittance
1210
1212
1214
1216
1218
1220
Wavenumber (cm⁻¹)

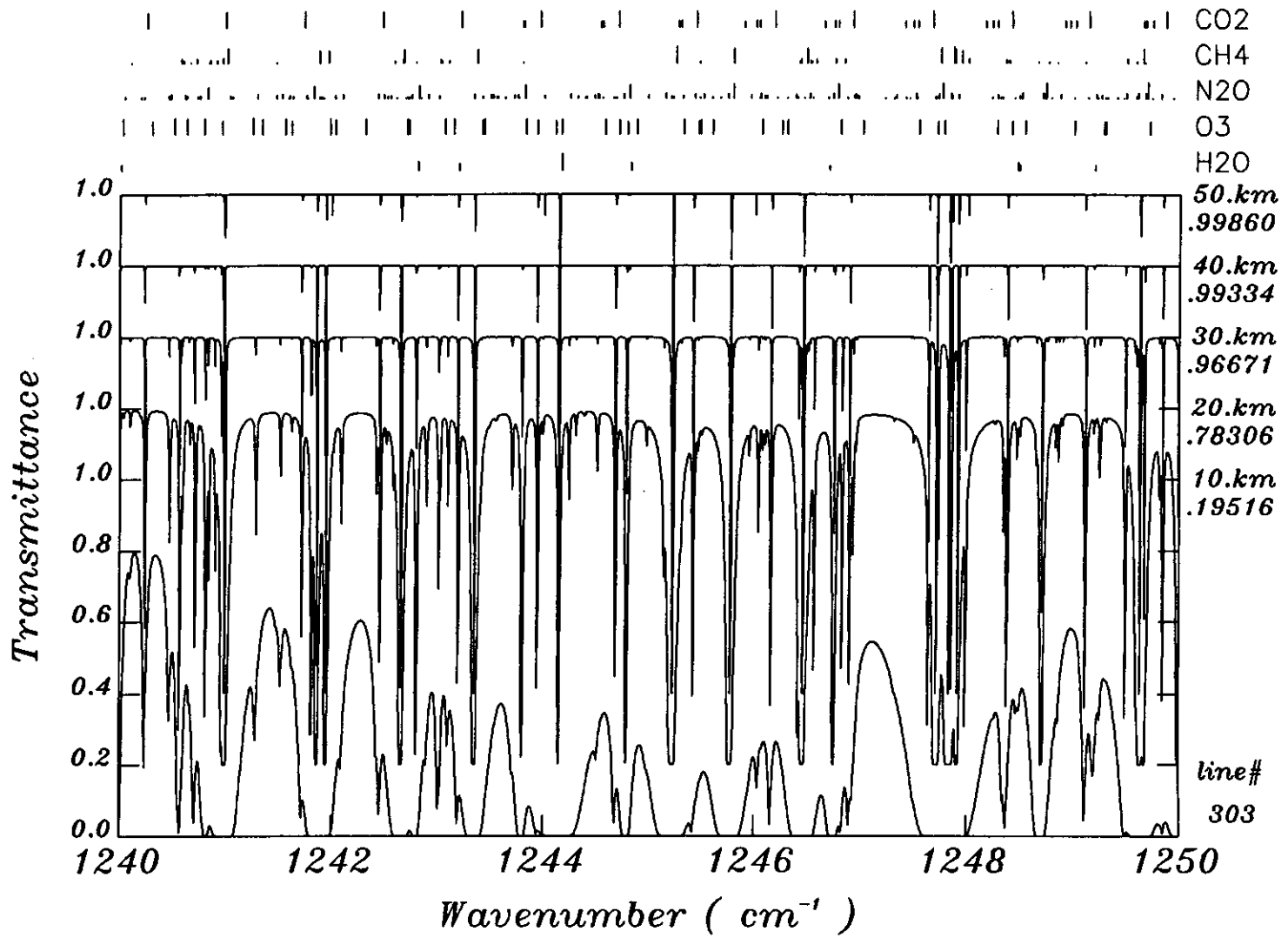

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
0.5
0.0
HN03
1.0000
N02
1.0000
C02
0.9991
CH4
0.9361
N20
0.9946
03
0.9970
H20
0.9972
1220
1222
1224
1226
1228
1230
Wavenumber (cm⁻¹)

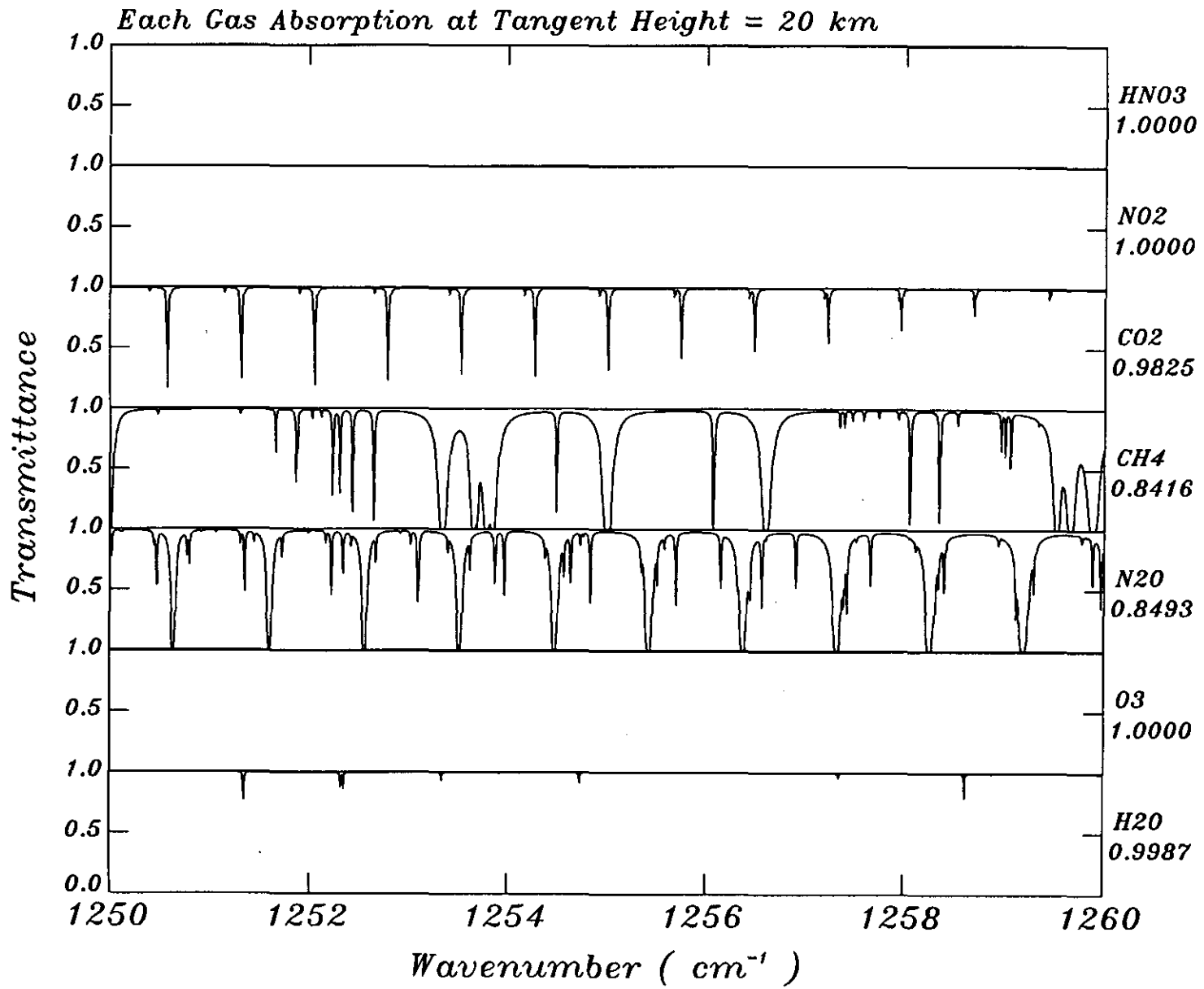

CO2
CH4
N2O
O3
H2O
50.km
.99962
40.km
.99777
30.km
.98778
20.km
.92517
10.km
.55268
line#
274
1.0
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
Transmittance
1220
1222
1224
1226
1228
1230
Wavenumber (cm⁻¹)

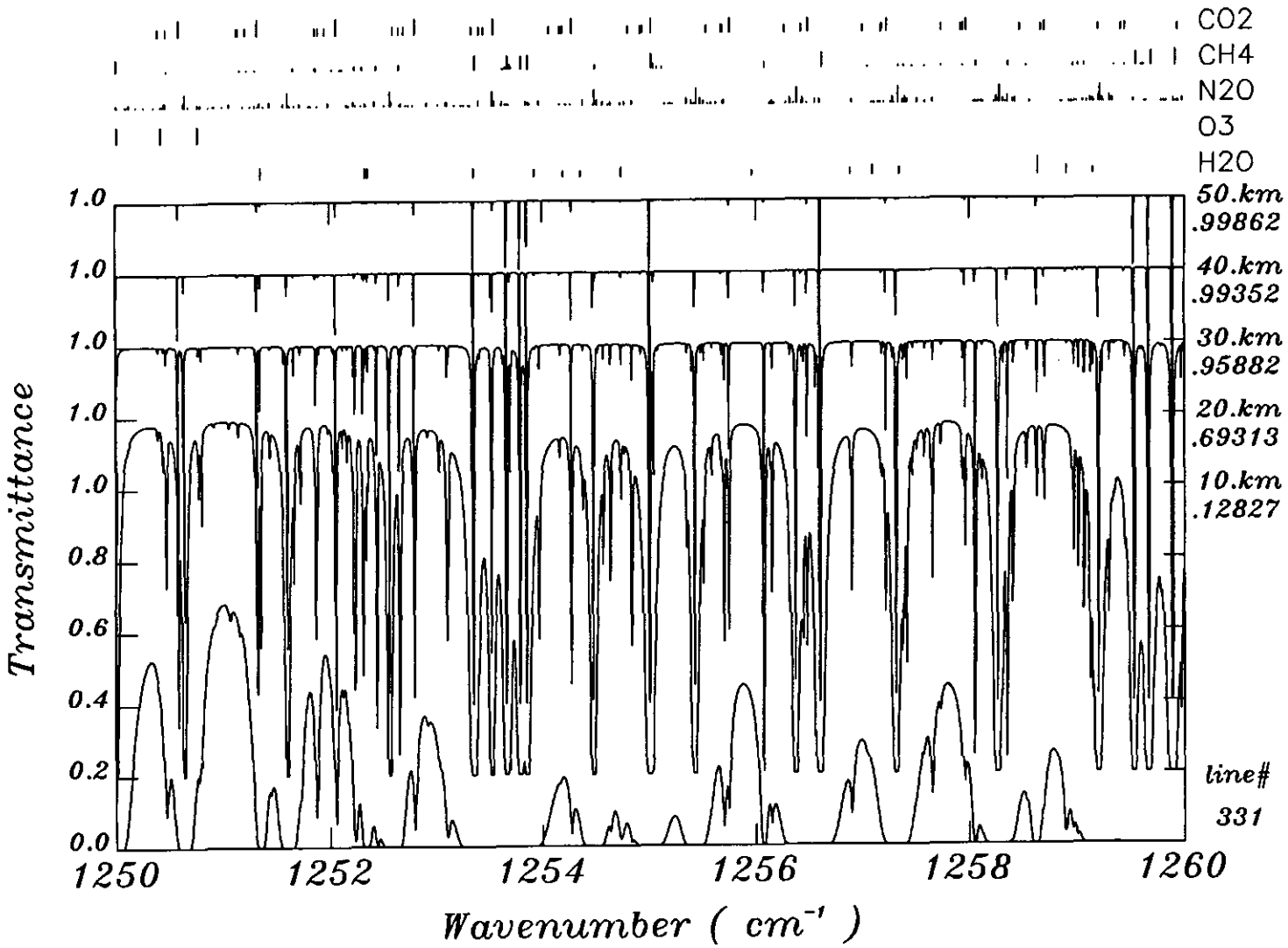

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
0.5
0.0
HN03
1.0000
N02
1.0000
C02
0.9923
CH4
0.9119
N20
0.9815
03
0.9998
H20
0.9997
1230
1232
1234
1236
1238
1240
Wavenumber (cm⁻¹)

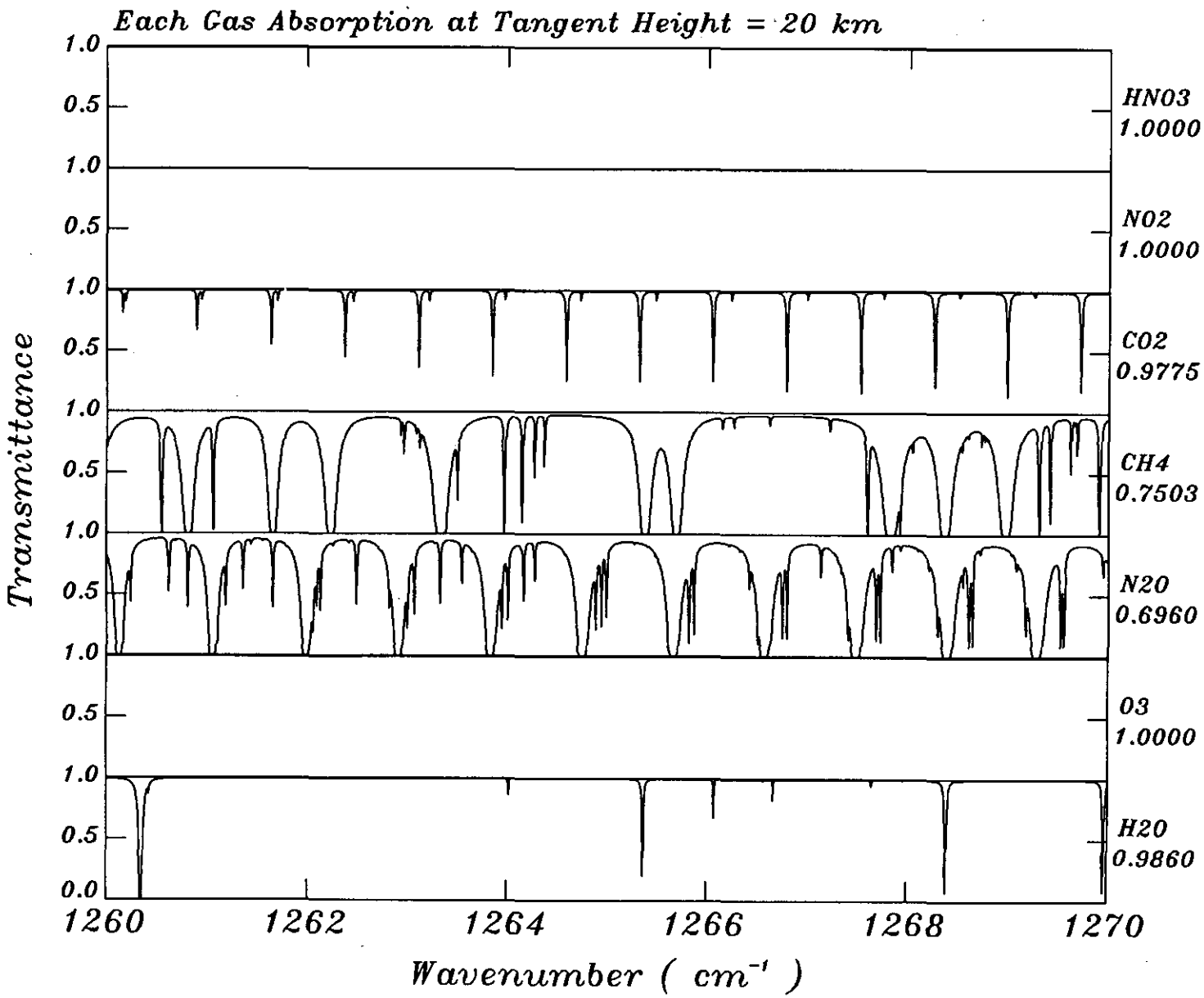

CO2
CH4
N2O
O3
H2O
50.km
.99949
40.km
.99696
30.km
.98372
20.km
.88915
10.km
.50556
line#
251
Transmittance
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
1230
1232
1234
1236
1238
1240
Wavenumber (cm⁻¹)

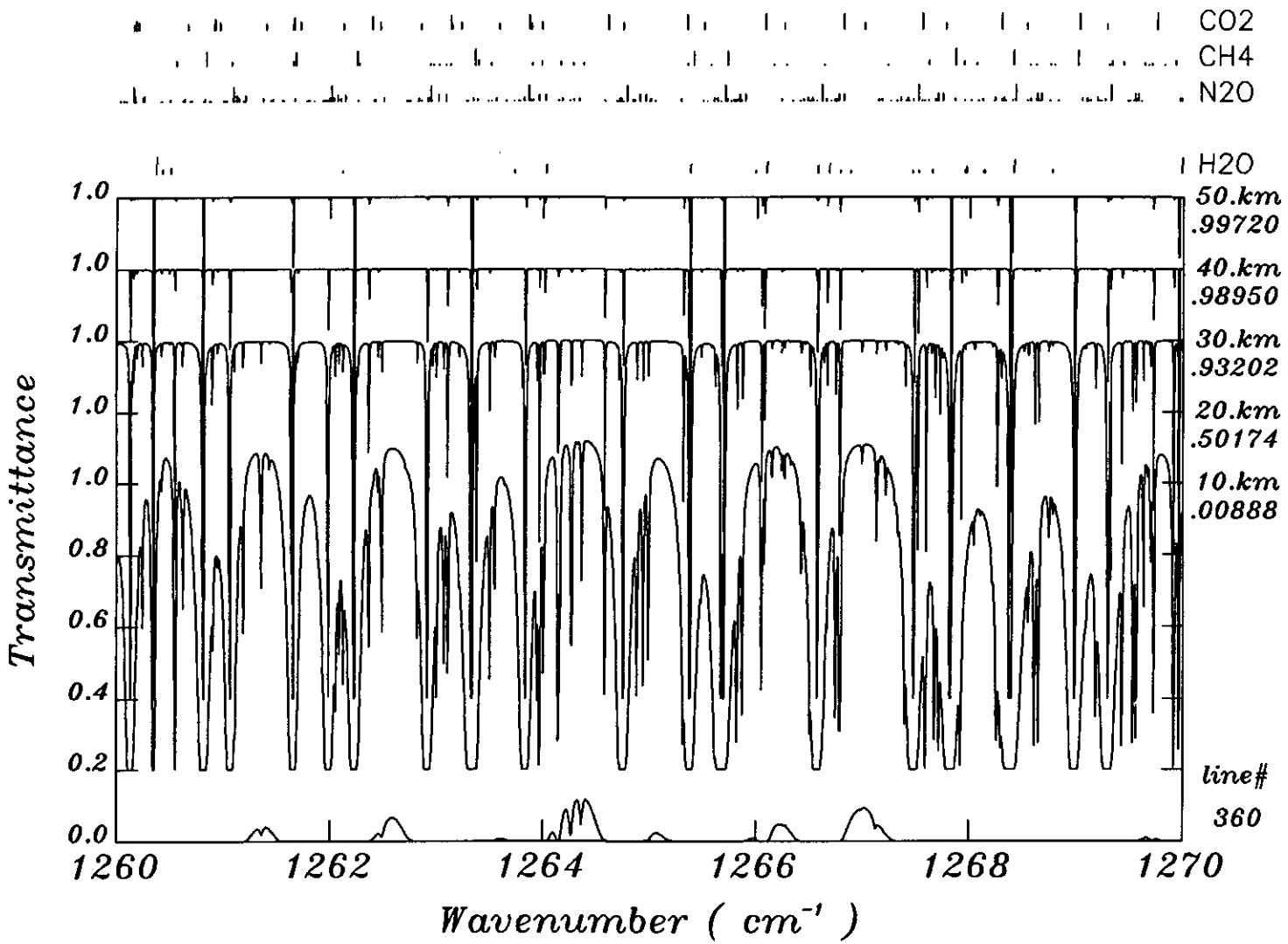

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
0.5
0.0
HN03
1.0000
NO2
1.0000
CO2
0.9771
CH4
0.8449
N20
0.9450
03
1.0000
H20
0.9962
1240
1242
1244
1246
1248
1250
Wavenumber (cm⁻¹)

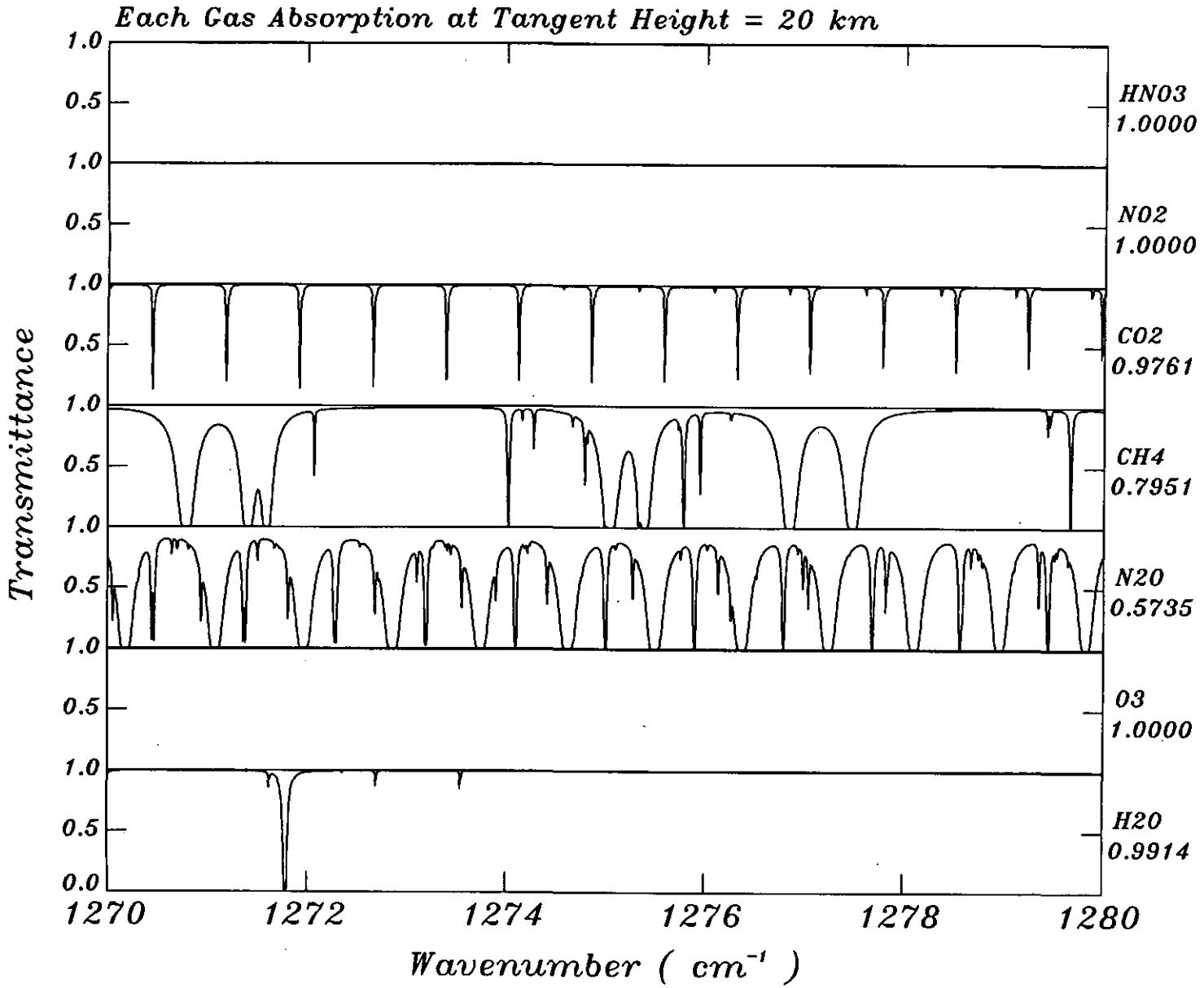

CO2
CH4
N2O
O3
H2O
50.km
.99860
40.km
.99334
30.km
.96671
20.km
.78306
10.km
.19516
line#
303
1.0
0.8
0.6
0.4
0.2
0.0
Transmittance
1240
1242
1244
1246
1248
1250
Wavenumber (cm⁻¹)

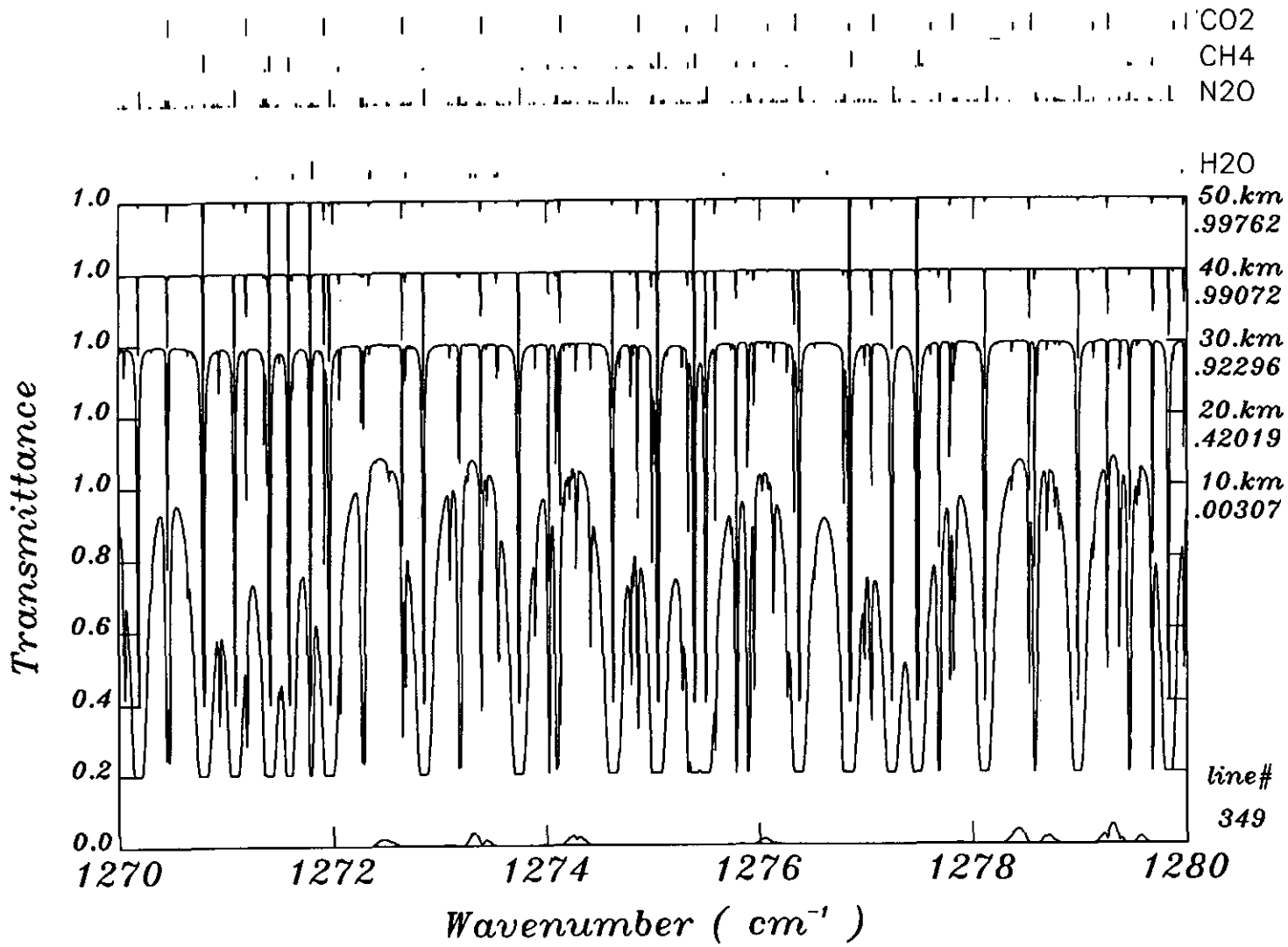

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
0.5
0.0
HNO3
1.0000
NO2
1.0000
CO2
0.9825
CH4
0.8416
N2O
0.8493
O3
1.0000
H2O
0.9987
1250
1252
1254
1256
1258
1260
Wavenumber (cm-1)

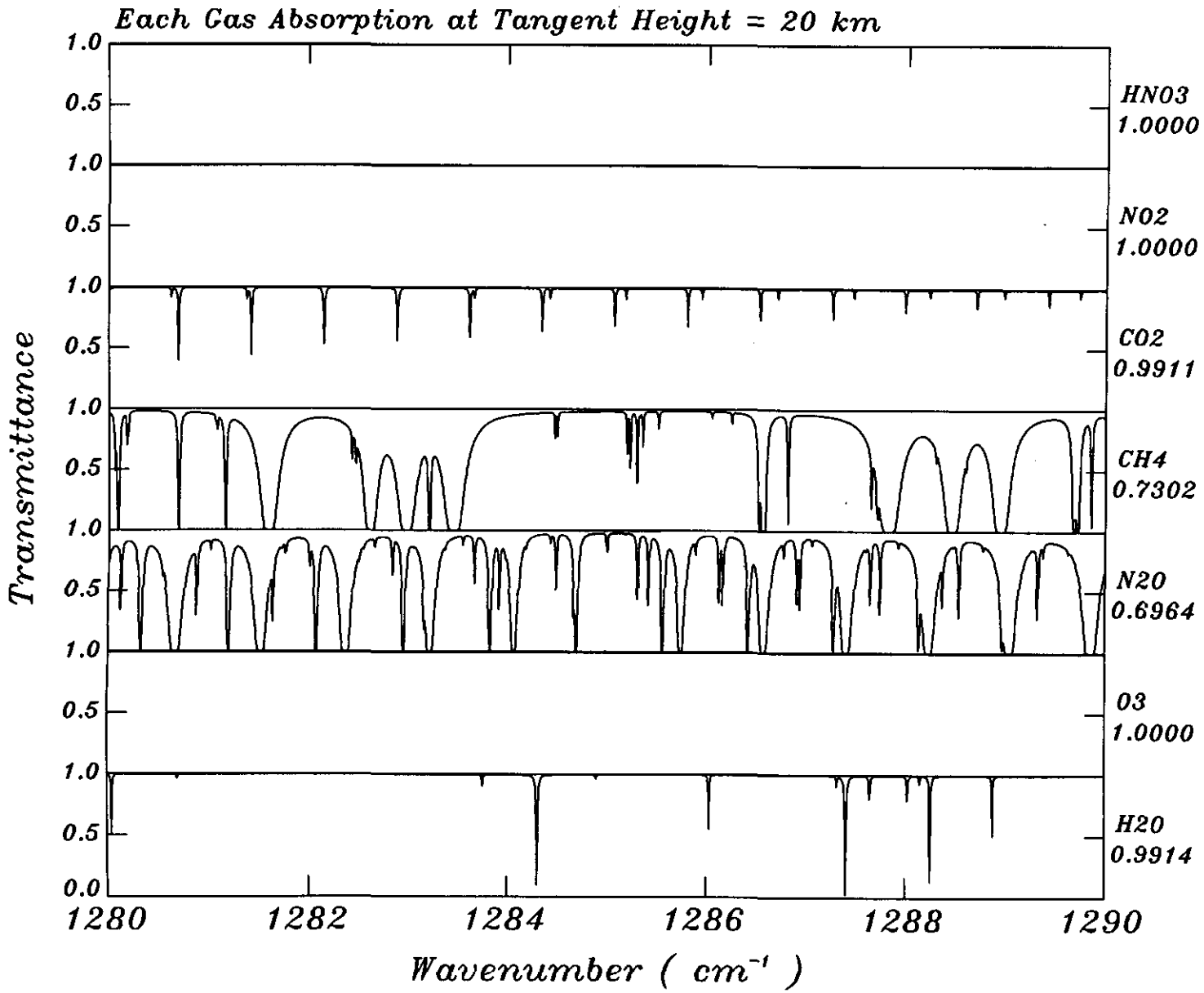

CO2
CH4
N2O
O3
H2O
50.km
.99862
40.km
.99352
30.km
.95882
20.km
.69313
10.km
.12827
line#
331
Transmittance
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
1250
1252
1254
1256
1258
1260
Wavenumber (cm⁻¹)

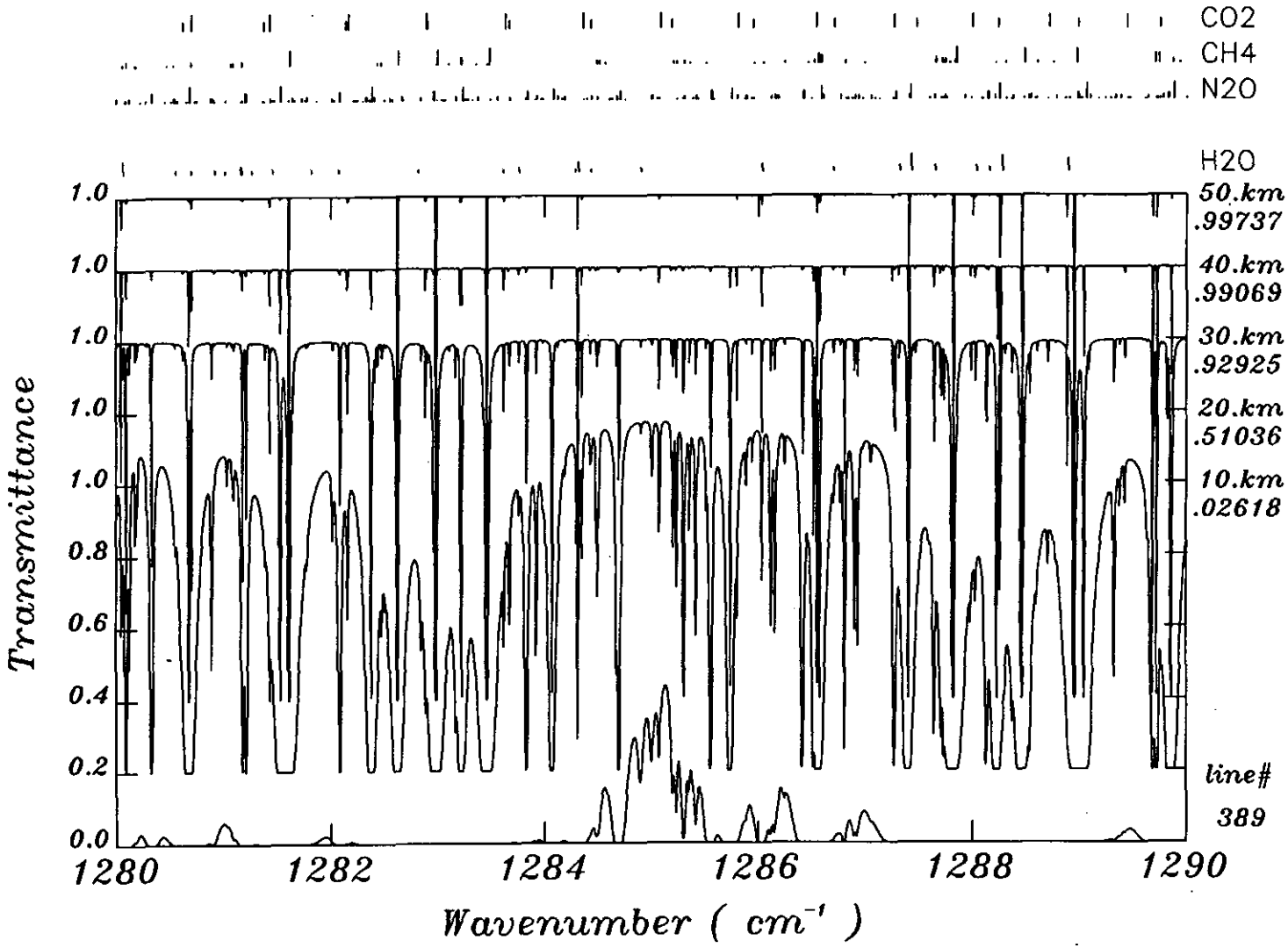

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
0.5
0.0
HN03
1.0000
N02
1.0000
C02
0.9775
CH4
0.7503
N20
0.6960
03
1.0000
H20
0.9860
1260
1262
1264
1266
1268
1270
Wavenumber (cm⁻¹)

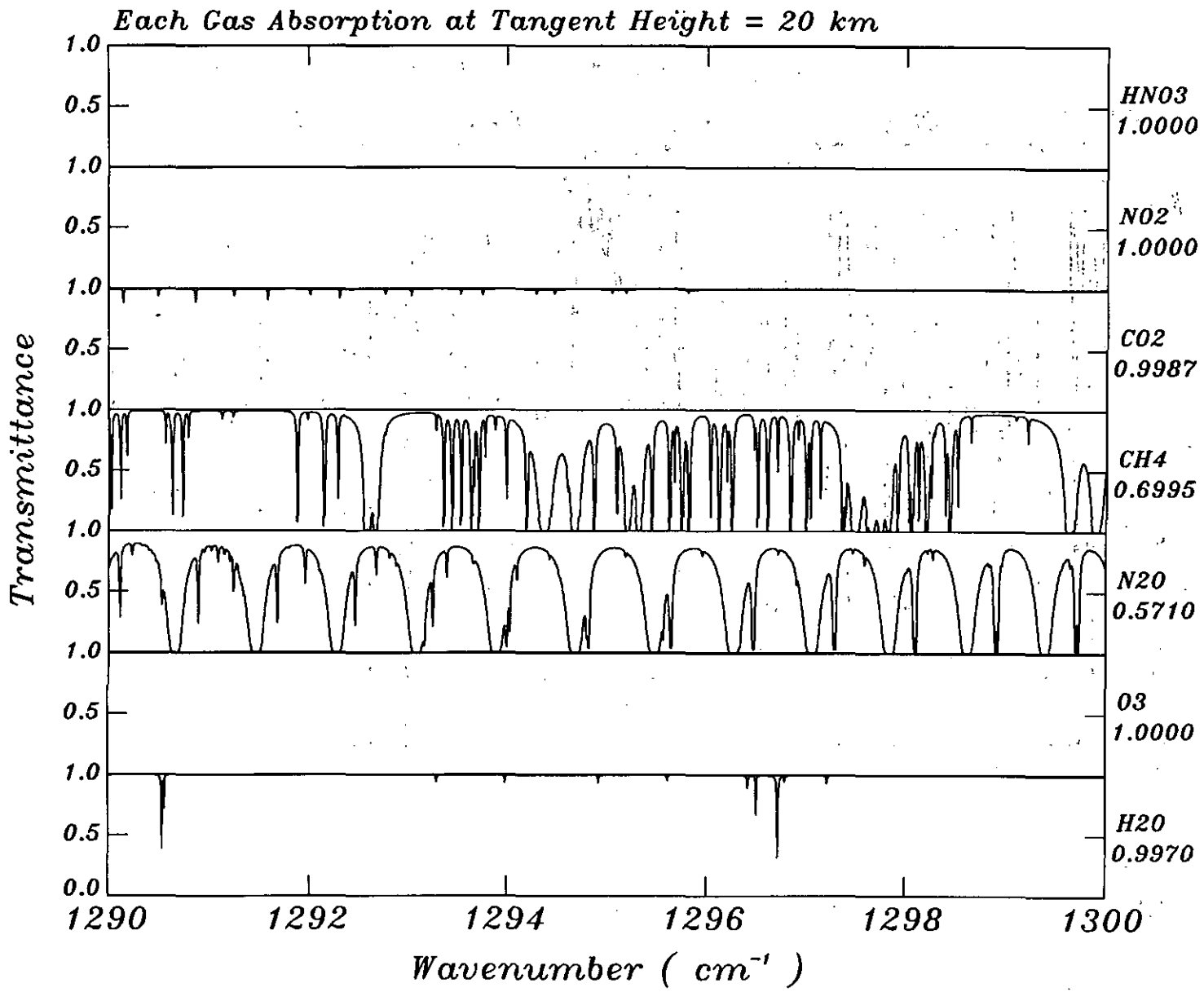

CO2
CH4
N2O
H2O
1.0
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
50.km
.99720
40.km
.98950
30.km
.93202
20.km
.50174
10.km
.00888
line#
360
Transmittance
1260
1262
1264
1266
1268
1270
Wavenumber (cm⁻¹)

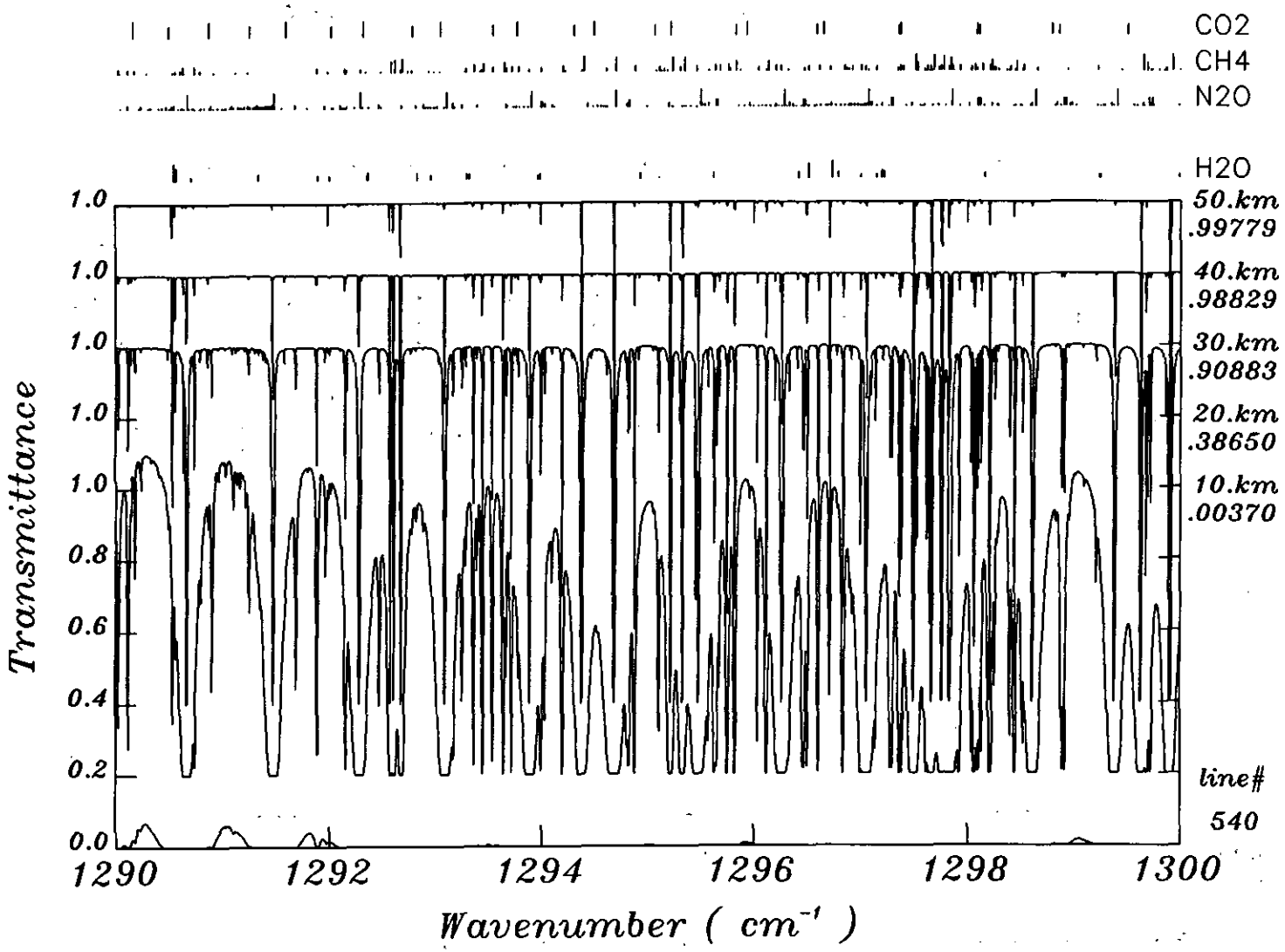

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
0.5
0.0
HN03
1.0000
N02
1.0000
CO2
0.9761
CH4
0.7951
N20
0.5735
03
1.0000
H20
0.9914
1270
1272
1274
1276
1278
1280
Wavenumber (cm⁻¹)

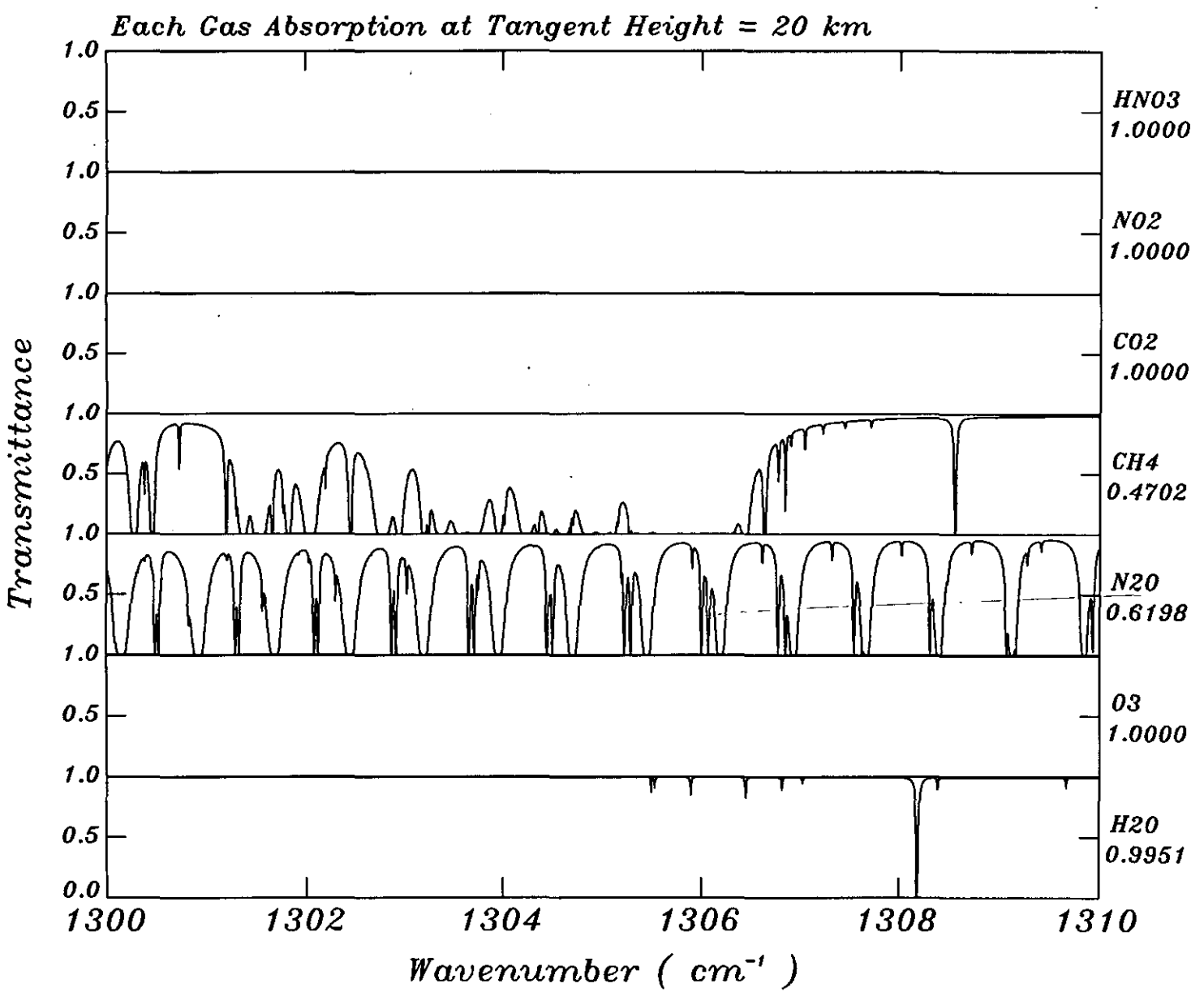

CO2
CH4
N2O
H2O
50.km
.99762
40.km
.99072
30.km
.92296
20.km
.42019
10.km
.00307
line#
349
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
Transmittance
1270
1272
1274
1276
1278
1280
Wavenumber (cm⁻¹)

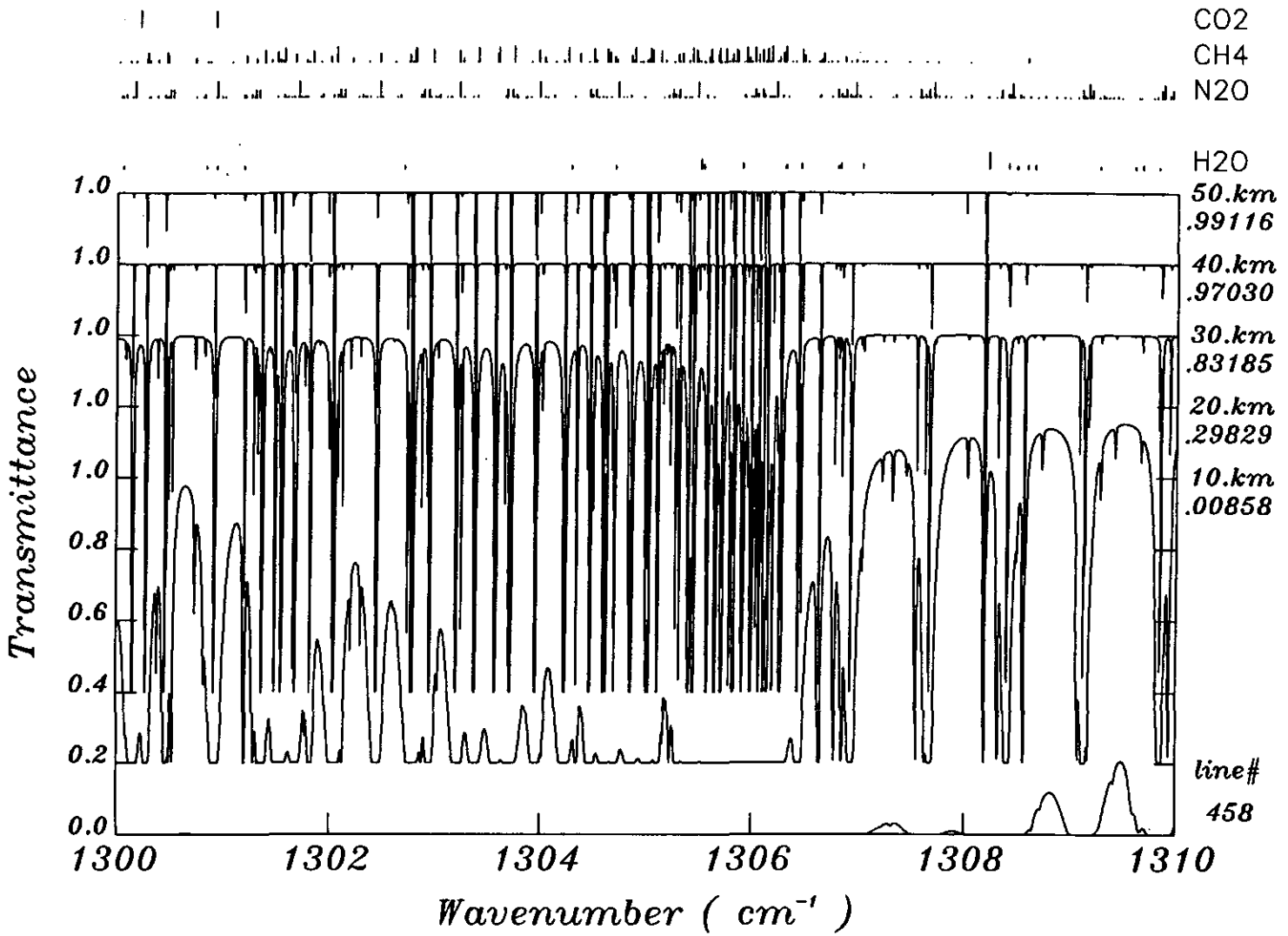

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
0.5
0.0
HN03
1.0000
NO2
1.0000
CO2
0.9911
CH4
0.7302
N20
0.6964
03
1.0000
H20
0.9914
1280
1282
1284
1286
1288
1290
Wavenumber (cm⁻¹)

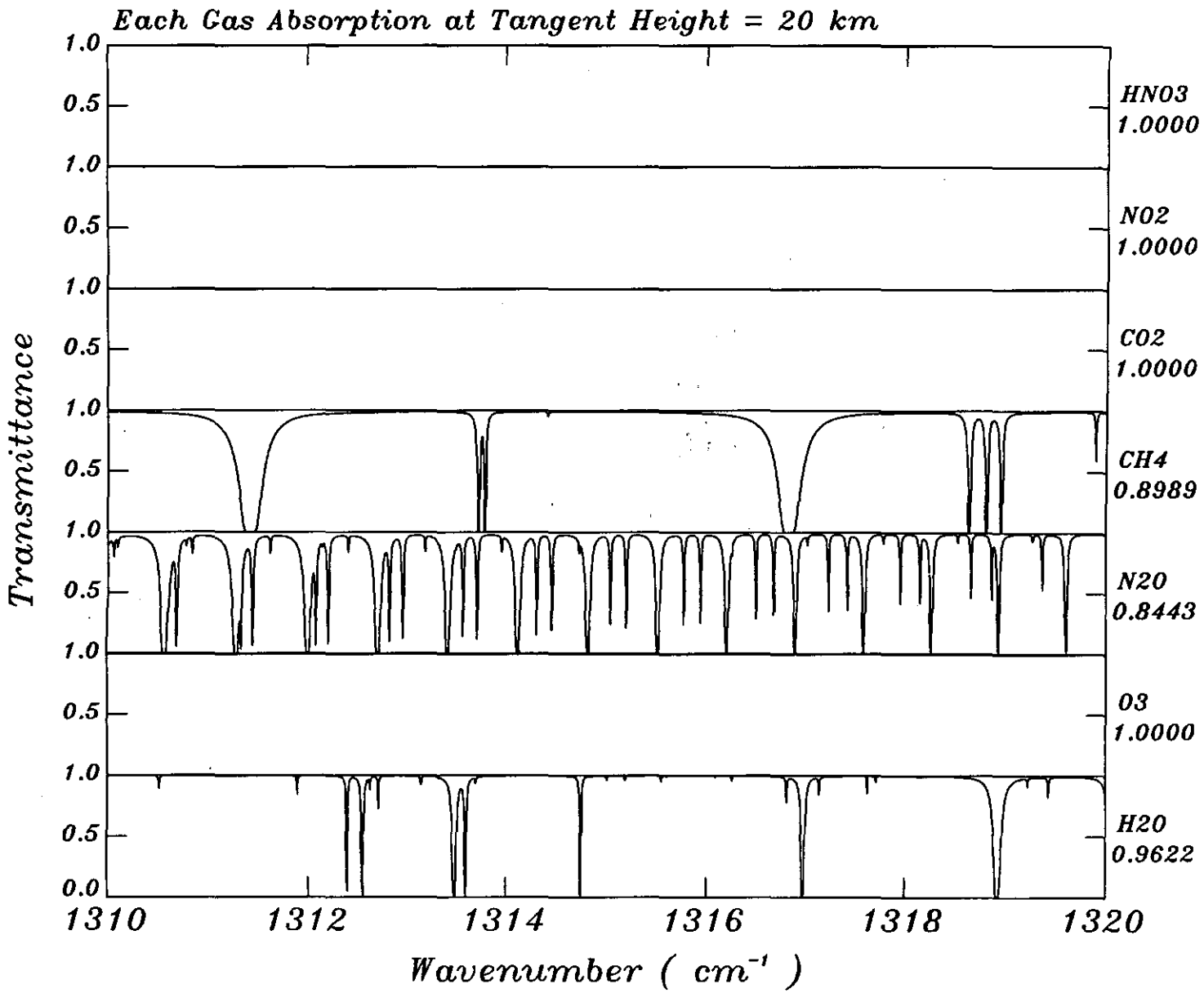

CO2
CH4
N2O
H2O
50.km
.99737
40.km
.99069
30.km
.92925
20.km
.51036
10.km
.02618
line#
389
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
Transmittance
1280
1282
1284
1286
1288
1290
Wavenumber (cm⁻¹)

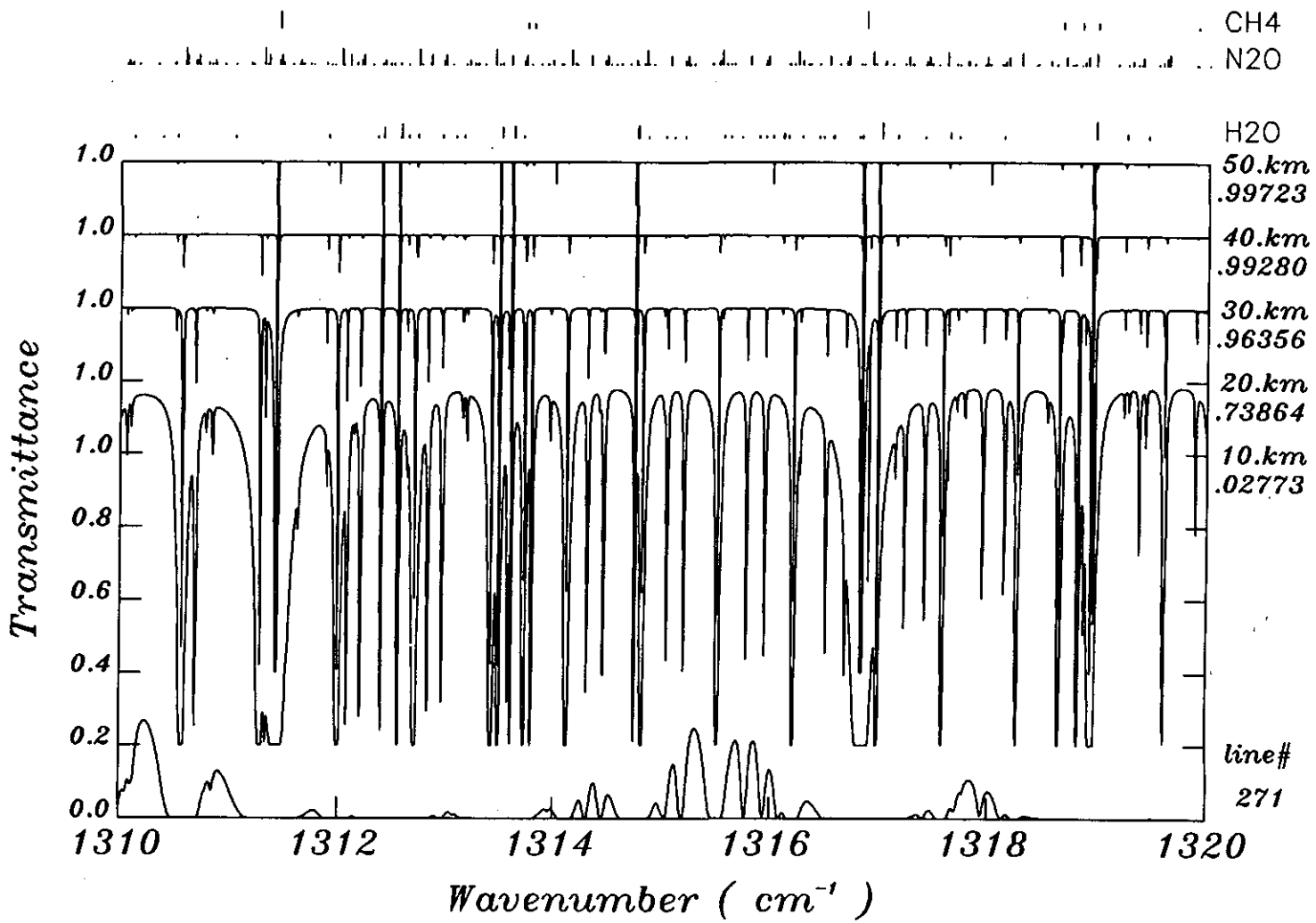

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
0.5
0.0
HN03
1.0000
NO2
1.0000
CO2
0.9987
CH4
0.6995
N20
0.5710
03
1.0000
H20
0.9970
1290
1292
1294
1296
1298
1300
Wavenumber (cm⁻¹)

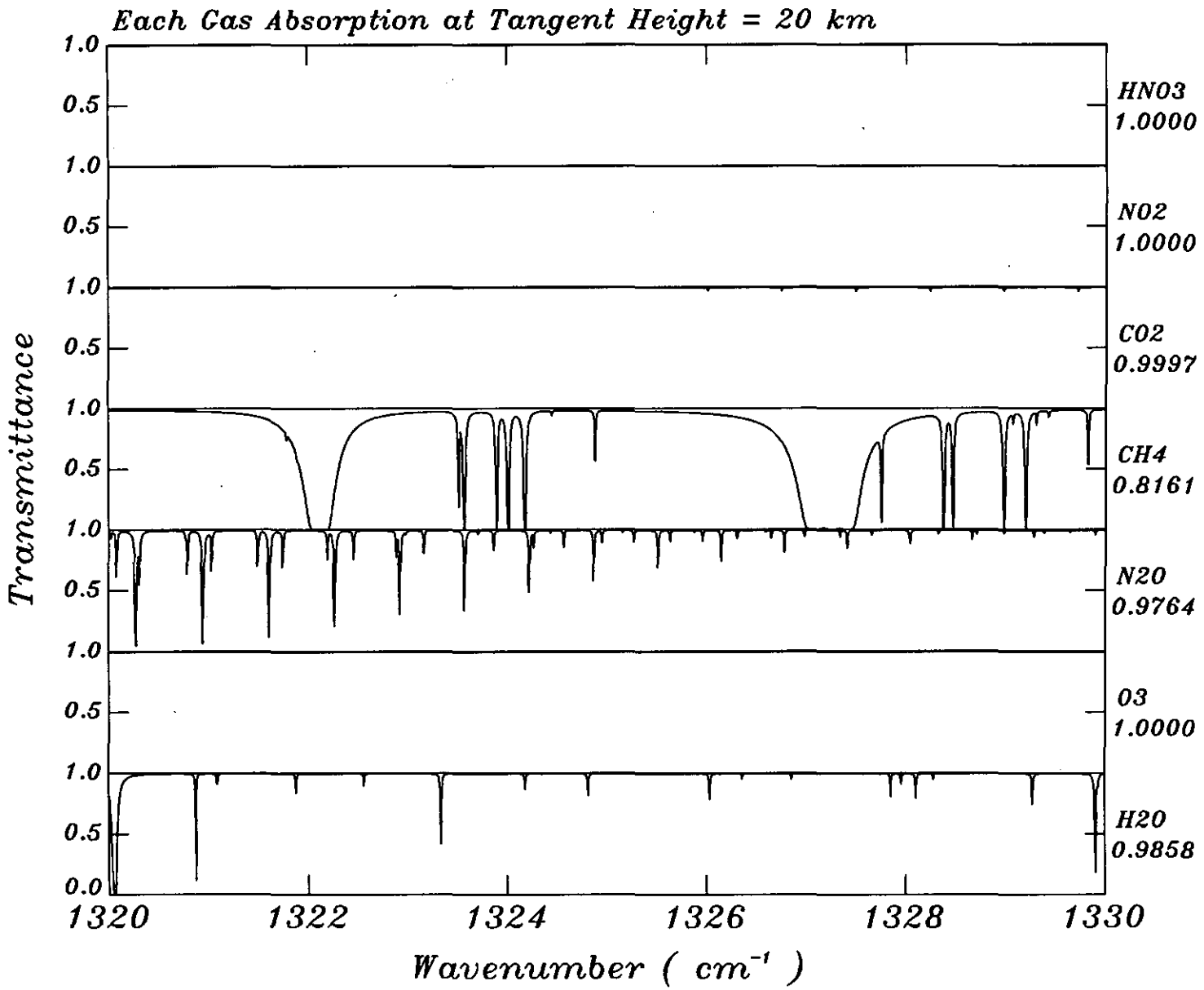

CO2
CH4
N2O
H2O
50.km
.99779
40.km
.98829
30.km
.90883
20.km
.38650
10.km
.00370
line#
540
Transmittance
1.0
0.8
0.6
0.4
0.2
0.0
1290
1292
1294
1296
1298
1300
Wavenumber (cm⁻¹)

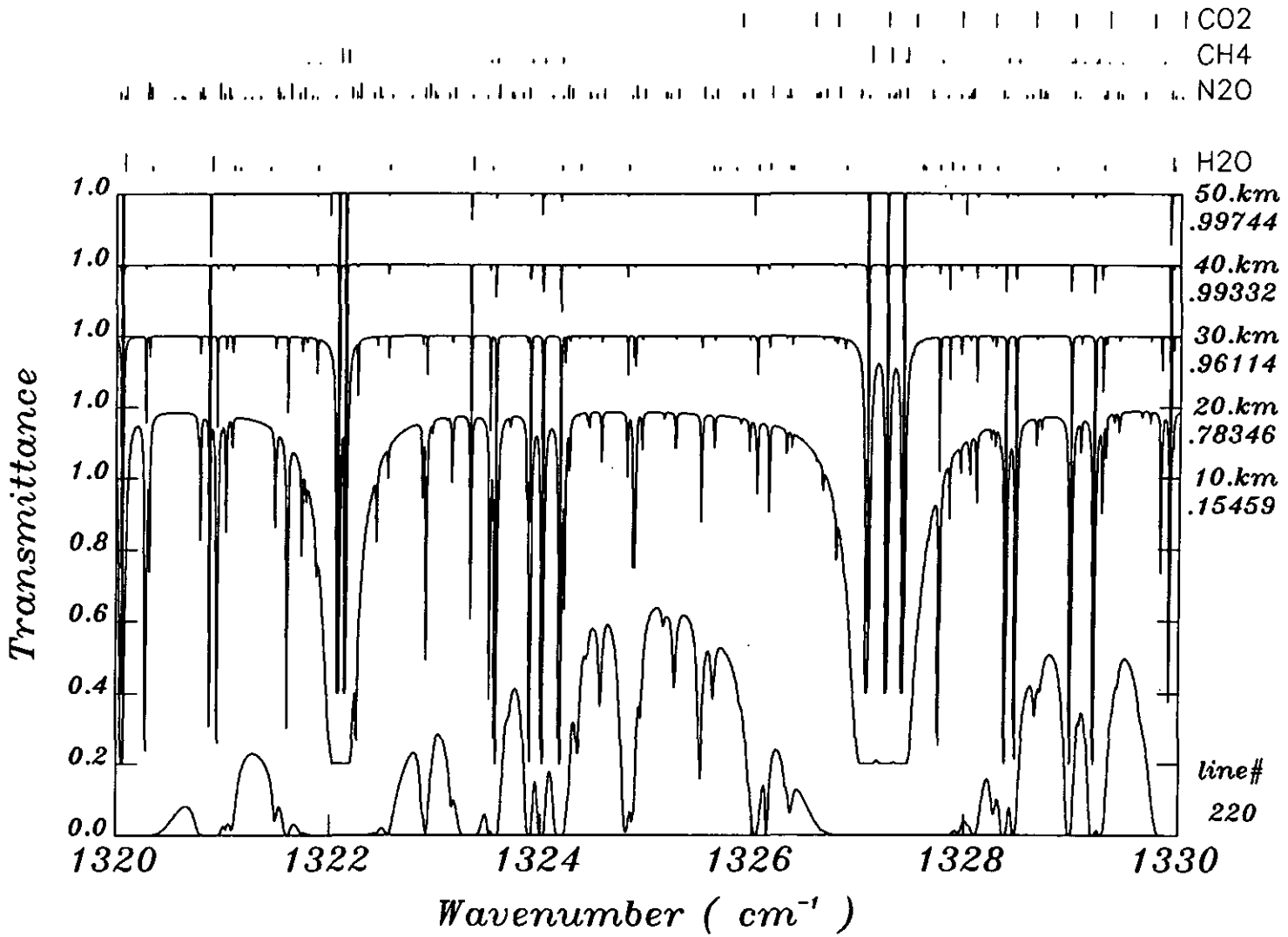

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
0.5
0.0
HNO3
1.0000
NO2
1.0000
CO2
1.0000
CH4
0.4702
N2O
0.6198
O3
1.0000
H2O
0.9951
1300
1302
1304
1306
1308
1310
Wavenumber (cm⁻¹)

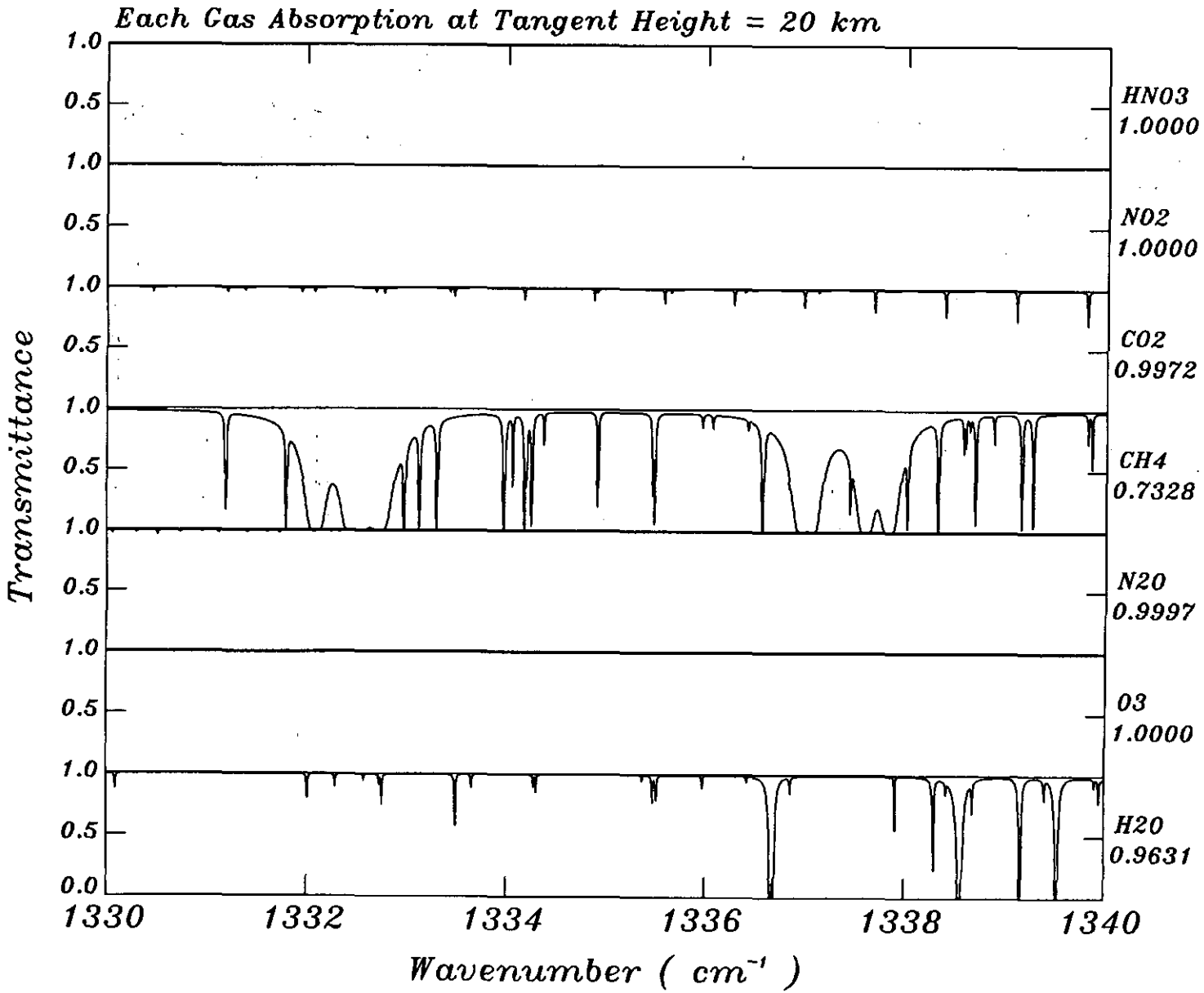

CO2
CH4
N2O
H2O
50.km
.99116
40.km
.97030
30.km
.83185
20.km
.29829
10.km
.00858
line#
458
Transmittance
1.0
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
1300
1302
1304
1306
1308
1310
Wavenumber (cm⁻¹)

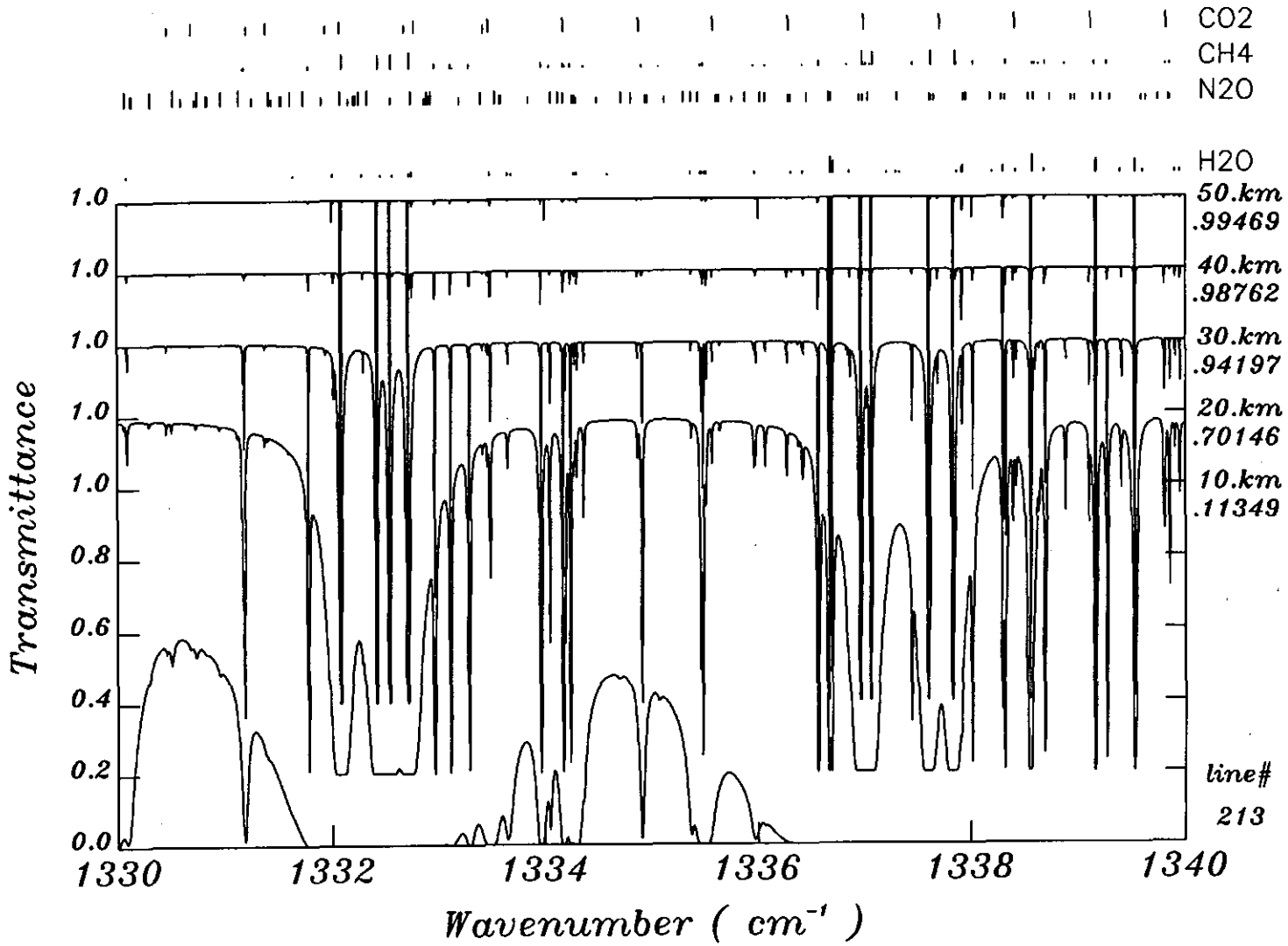

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
0.5
0.0
HNO3
1.0000
NO2
1.0000
CO2
1.0000
CH4
0.8989
N2O
0.8443
O3
1.0000
H2O
0.9622
1310
1312
1314
1316
1318
1320
Wavenumber (cm⁻¹)

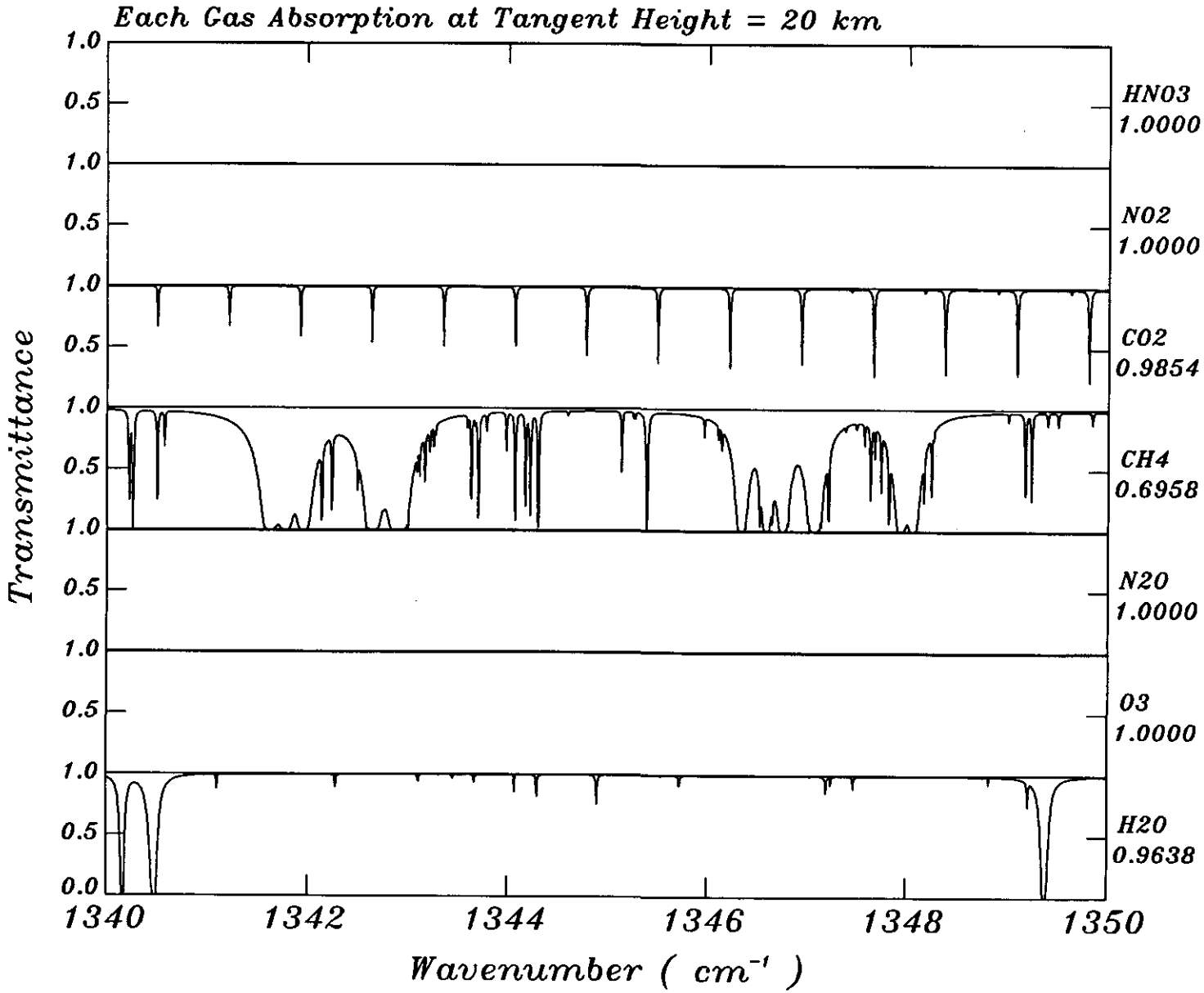

CH4
N2O
H2O
50.km
.99723
40.km
.99280
30.km
.96356
20.km
.73864
10.km
.02773
line#
271
Transmittance
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
1310
1312
1314
1316
1318
1320
Wavenumber (cm⁻¹)

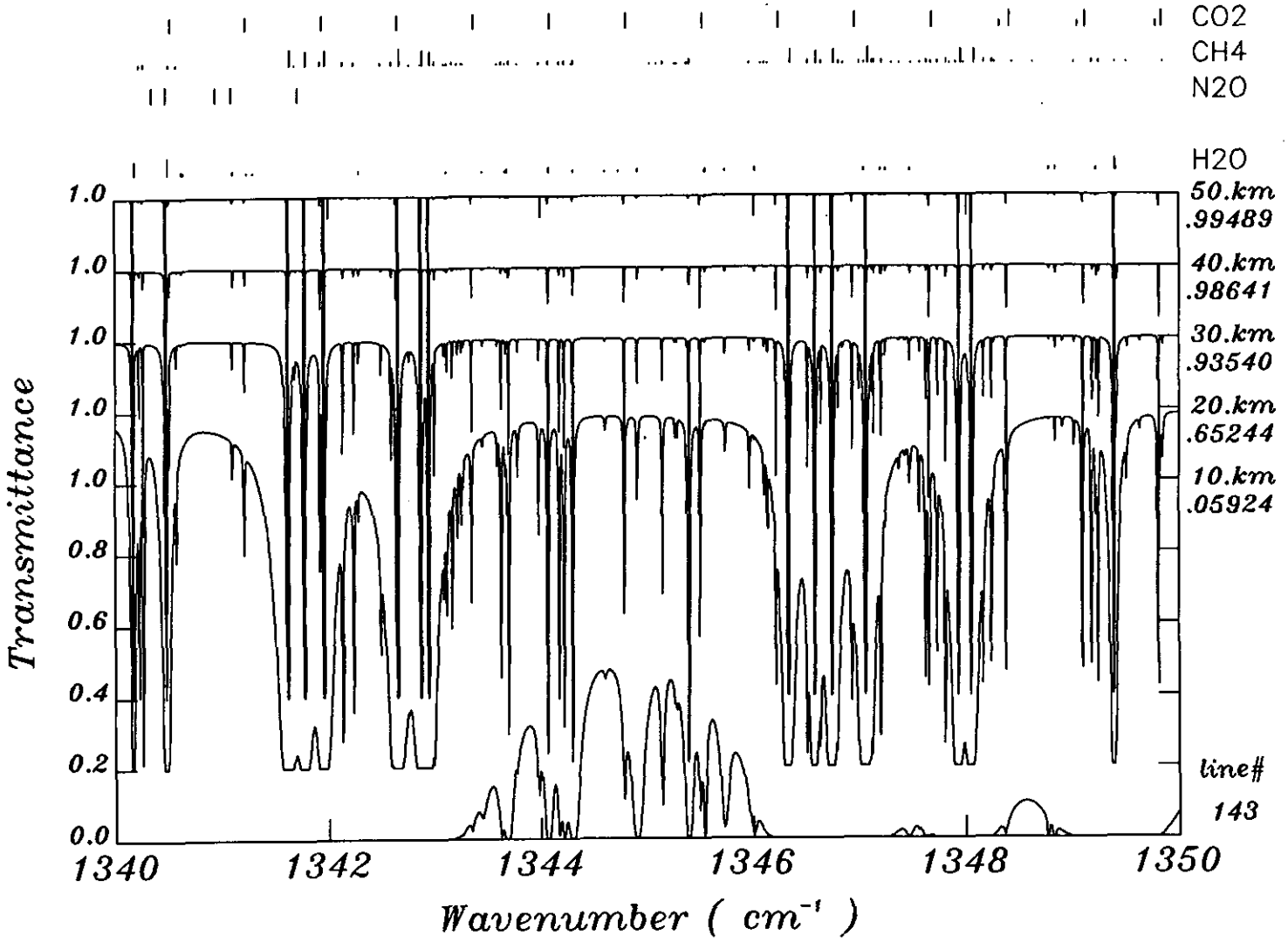

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
0.5
0.0
HNO3
1.0000
NO2
1.0000
CO2
0.9997
CH4
0.8161
N2O
0.9764
O3
1.0000
H2O
0.9858
1320
1322
1324
1326
1328
1330
Wavenumber (cm⁻¹)

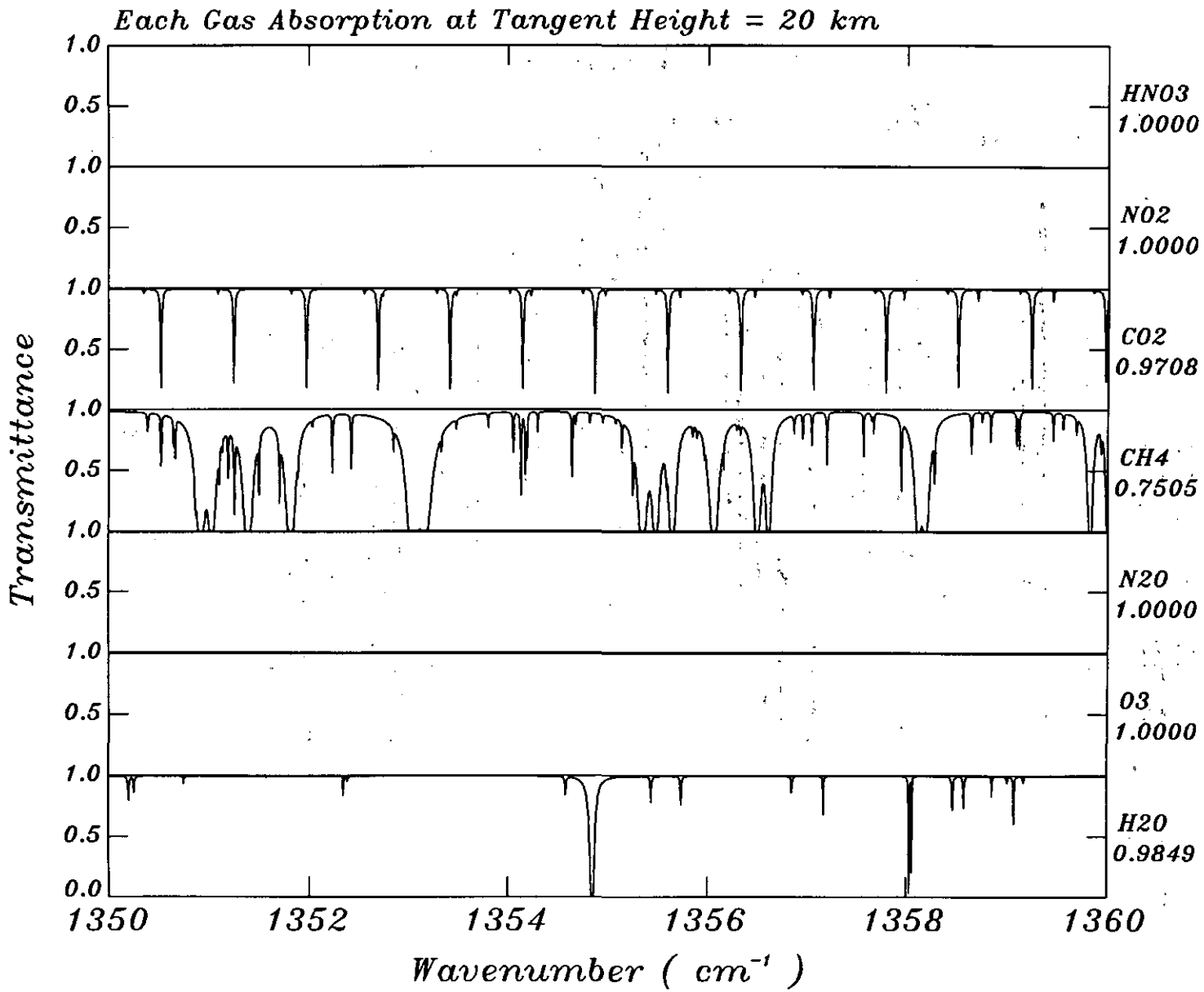

CO2
CH4
N2O
H2O
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
Transmittance
50.km
.99744
40.km
.99332
30.km
.96114
20.km
.78346
10.km
.15459
line#
220
1320
1322
1324
1326
1328
1330
Wavenumber (cm⁻¹)

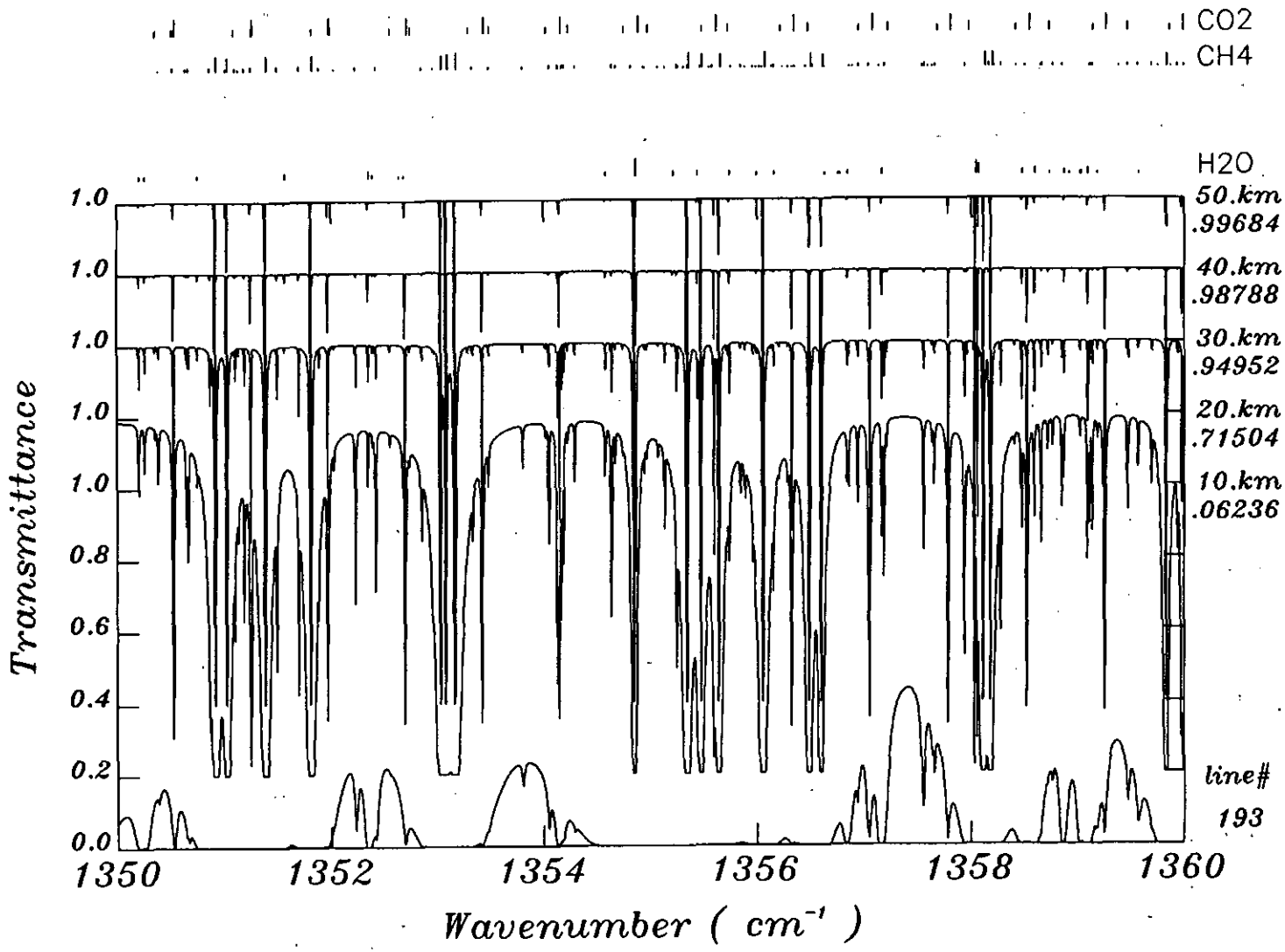

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
0.5
0.0
HN03
1.0000
NO2
1.0000
CO2
0.9972
CH4
0.7328
N20
0.9997
03
1.0000
H20
0.9631
1330
1332
1334
1336
1338
1340
Wavenumber (cm⁻¹)

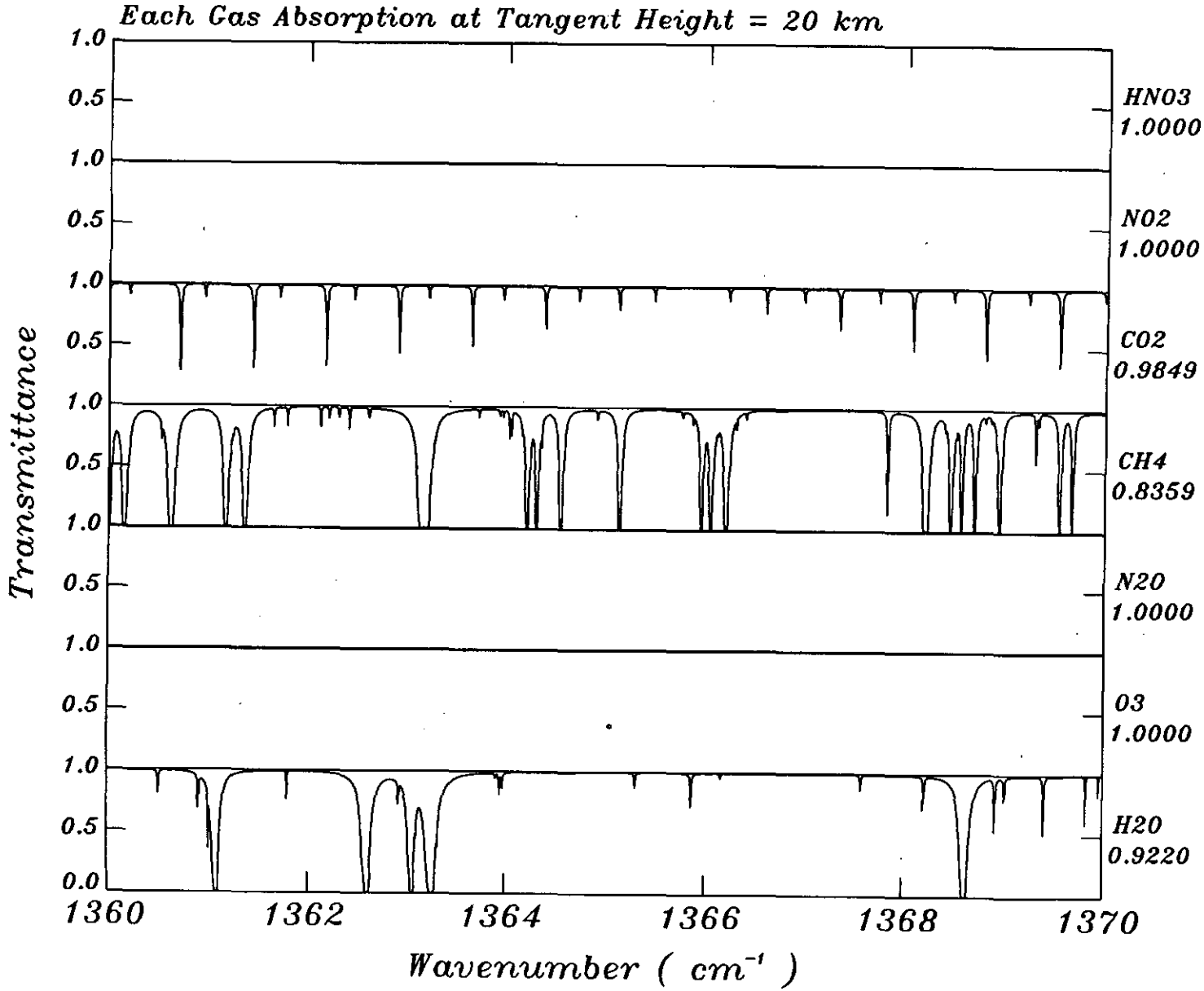

CO2
CH4
N2O
H2O
50.km
.99469
40.km
.98762
30.km
.94197
20.km
.70146
10.km
.11349
line#
213
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
Transmittance
1330
1332
1334
1336
1338
1340
Wavenumber (cm⁻¹)

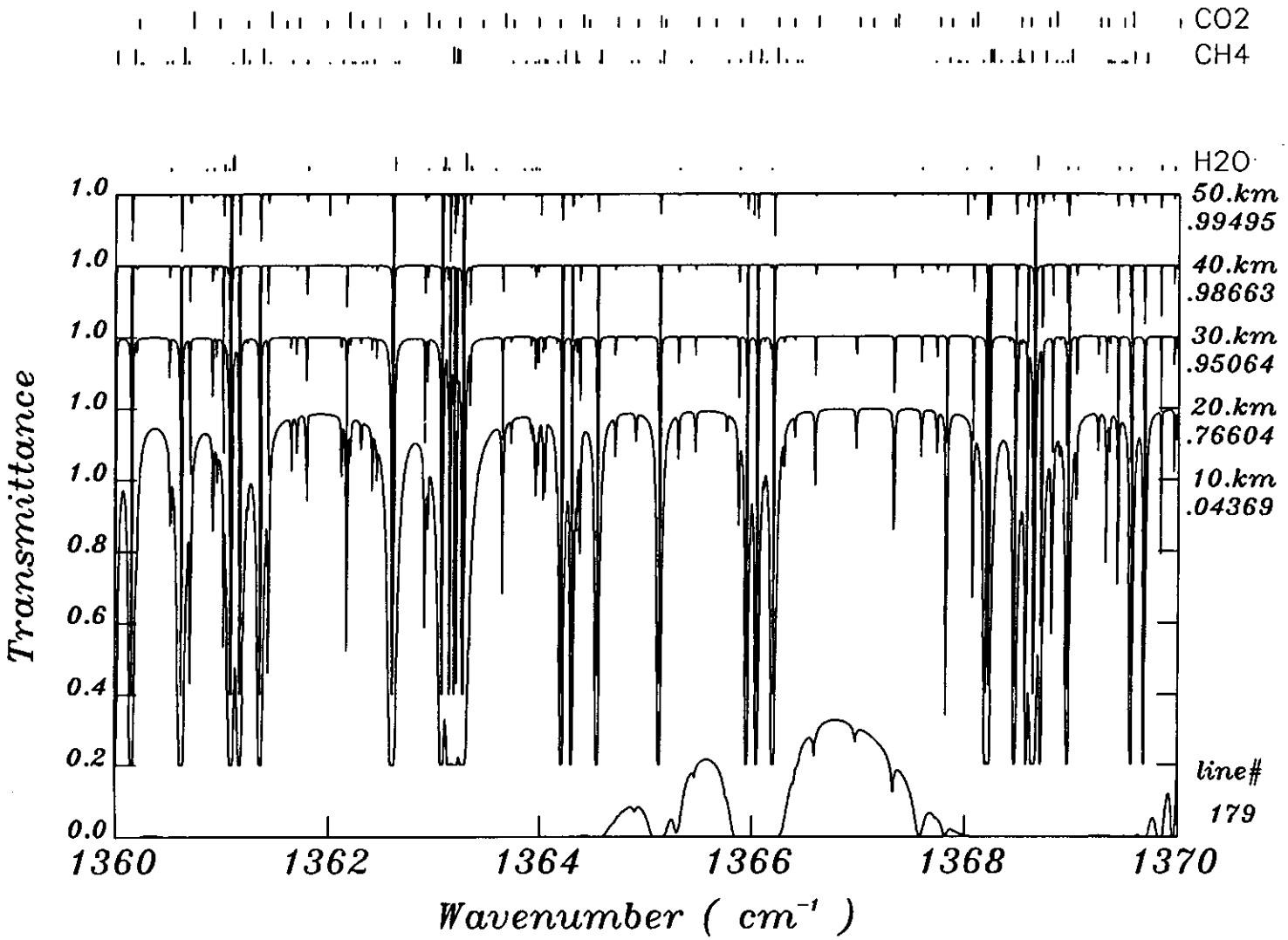

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
0.5
0.0
HN03
1.0000
NO2
1.0000
CO2
0.9854
CH4
0.6958
N20
1.0000
03
1.0000
H20
0.9638
1340
1342
1344
1346
1348
1350
Wavenumber (cm⁻¹)

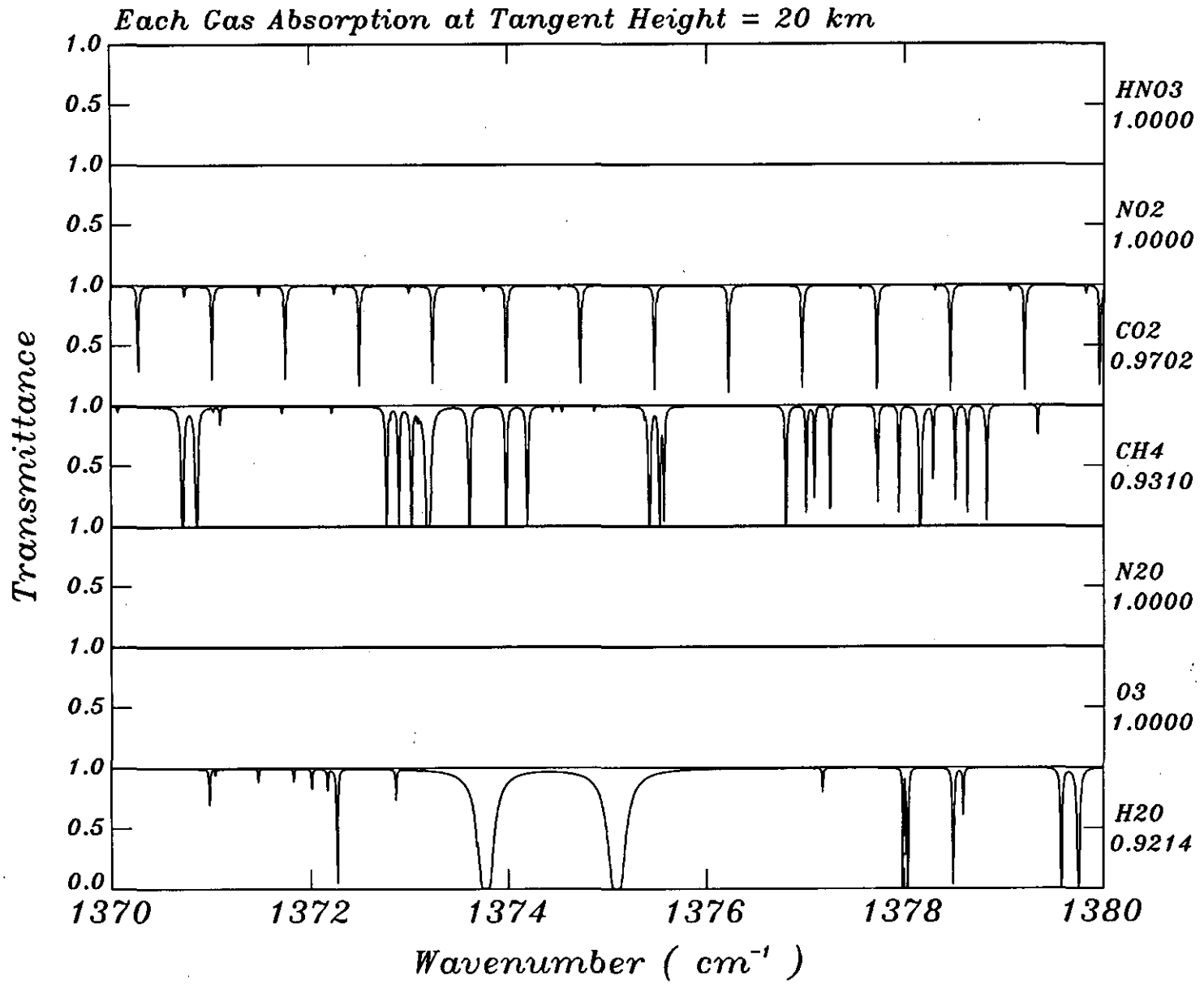

CO2
CH4
N2O
H2O
50.km
.99489
40.km
.98641
30.km
.93540
20.km
.65244
10.km
.05924
line#
143
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
Transmittance
1340
1342
1344
1346
1348
1350
Wavenumber (cm⁻¹)

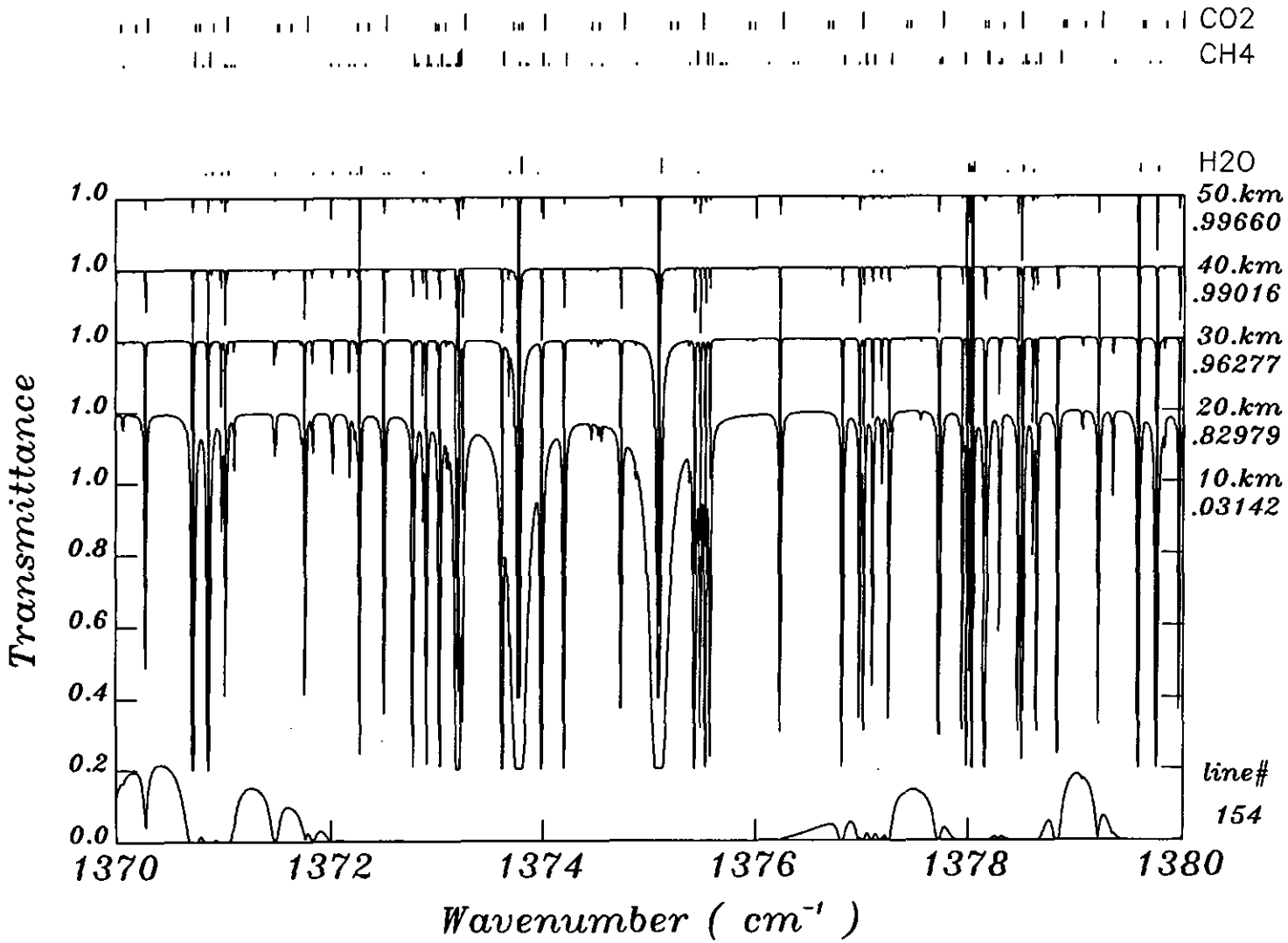

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
0.5
0.0
HN03
1.0000
NO2
1.0000
CO2
0.9708
CH4
0.7505
N20
1.0000
03
1.0000
H20
0.9849
1350
1352
1354
1356
1358
1360
Wavenumber (cm⁻¹)

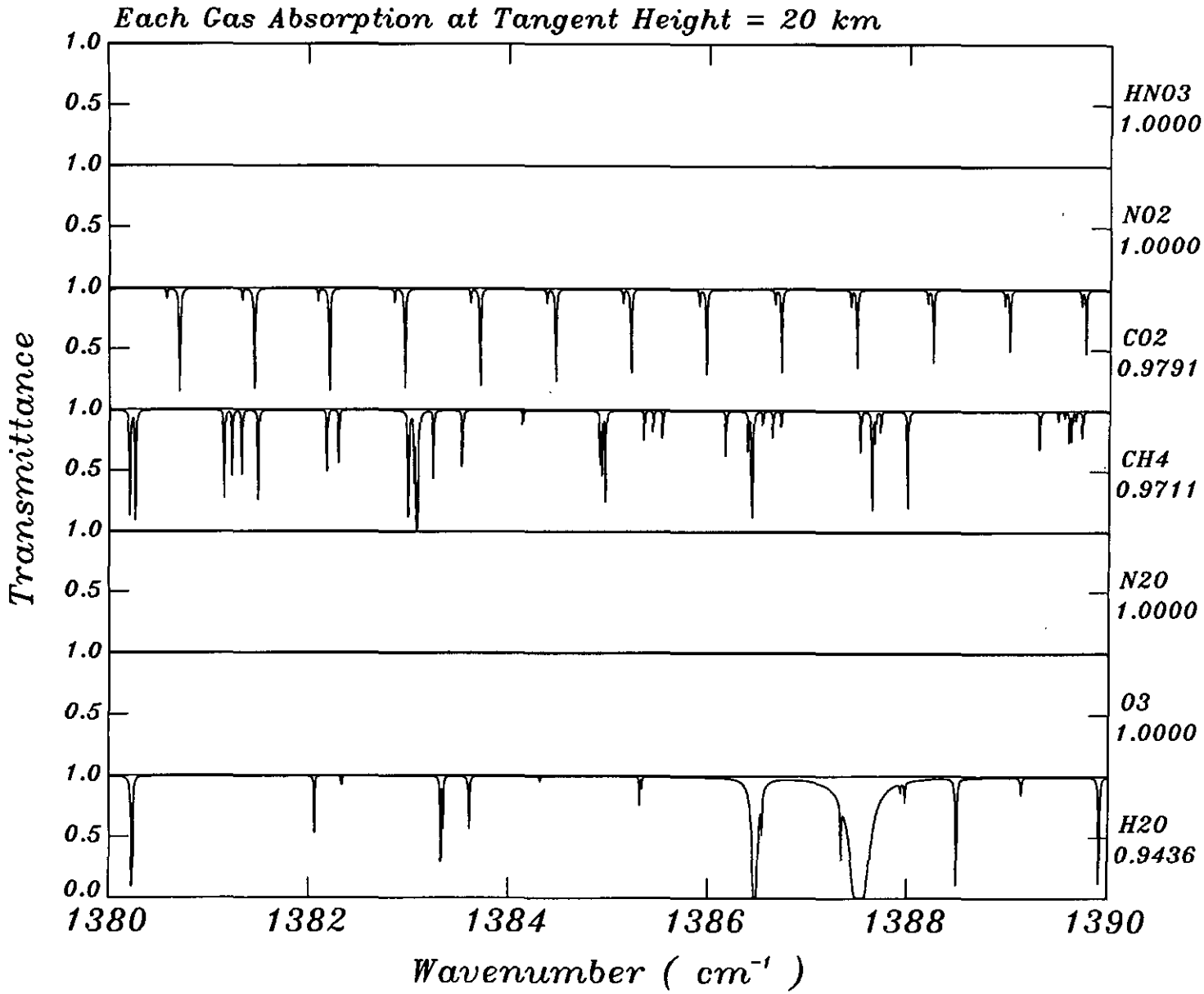

CO2
CH4
H2O
50.km
.99684
40.km
.98788
30.km
.94952
20.km
.71504
10.km
.06236
line#
193
Transmittance
1.0
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
1350
1352
1354
1356
1358
1360
Wavenumber (cm⁻¹)

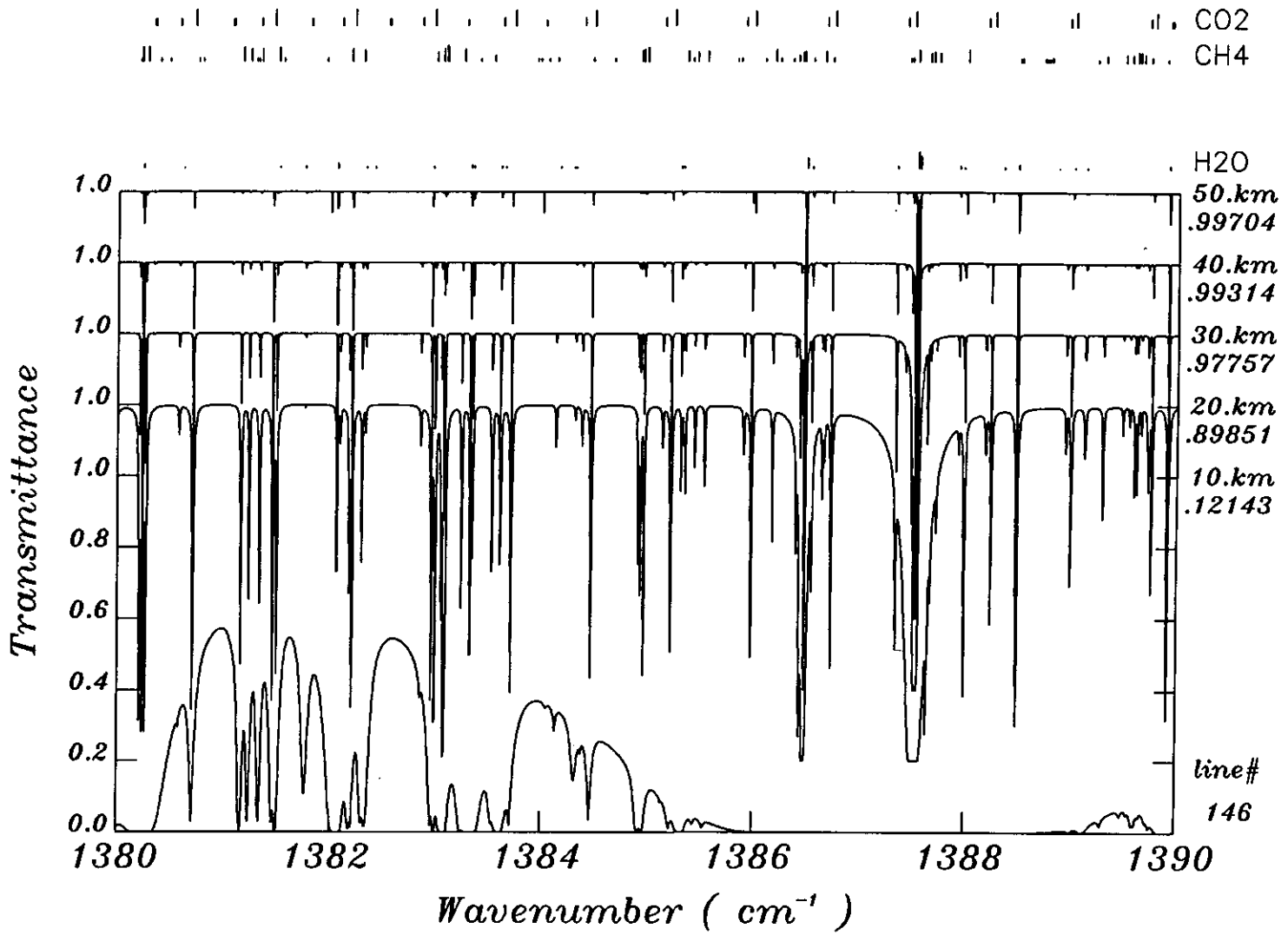

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
0.5
HNO3
1.0000
NO2
1.0000
CO2
0.9849
CH4
0.8359
N2O
1.0000
O3
1.0000
H2O
0.9220
0.0
1360
1362
1364
1366
1368
1370
Wavenumber (cm⁻¹)

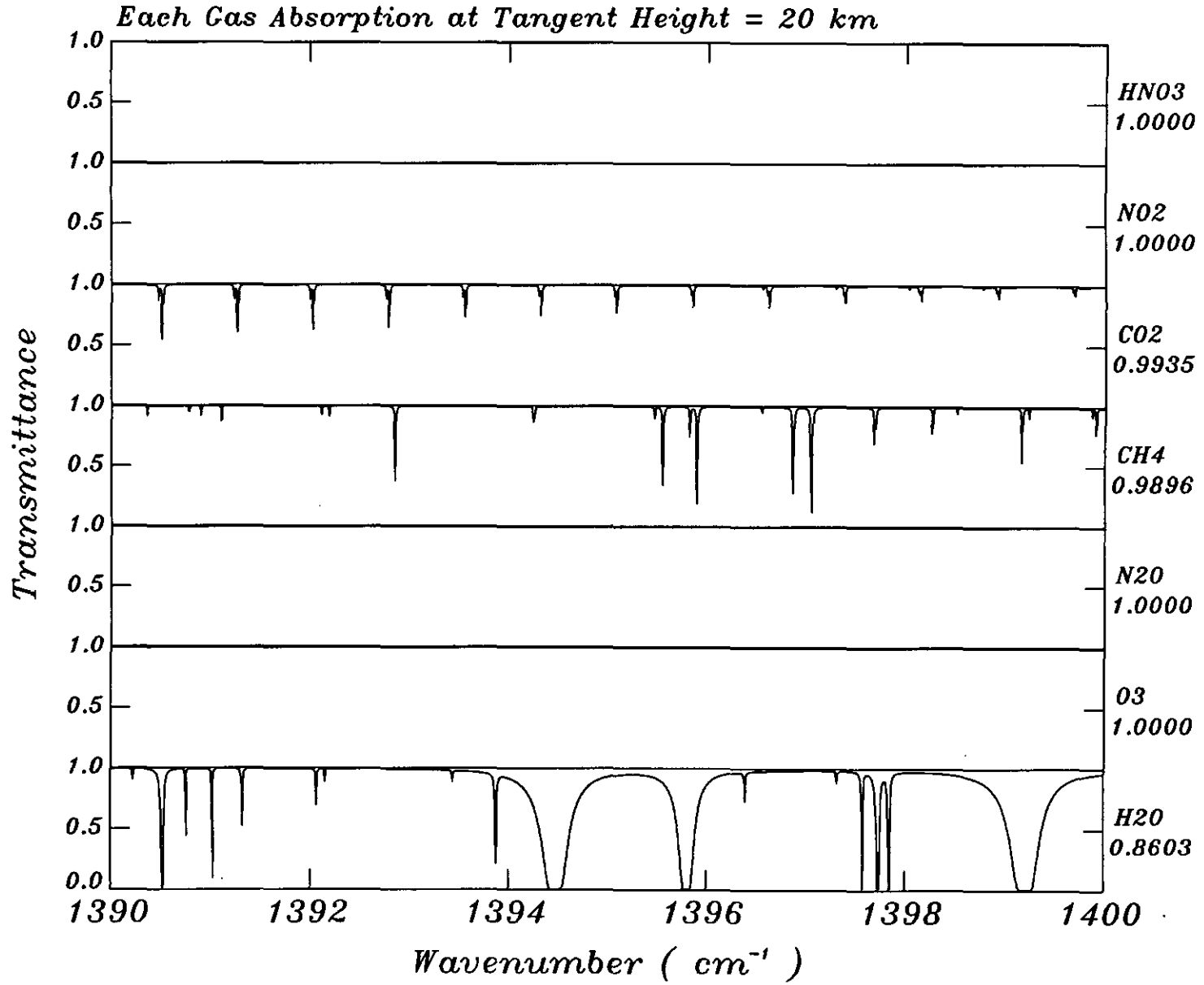

CO2
CH4
H2O
50.km
.99495
40.km
.98663
30.km
.95064
20.km
.76604
10.km
.04369
line#
179
Transmittance
1.0
0.8
0.6
0.4
0.2
0.0
1360
1362
1364
1366
1368
1370
Wavenumber (cm⁻¹)

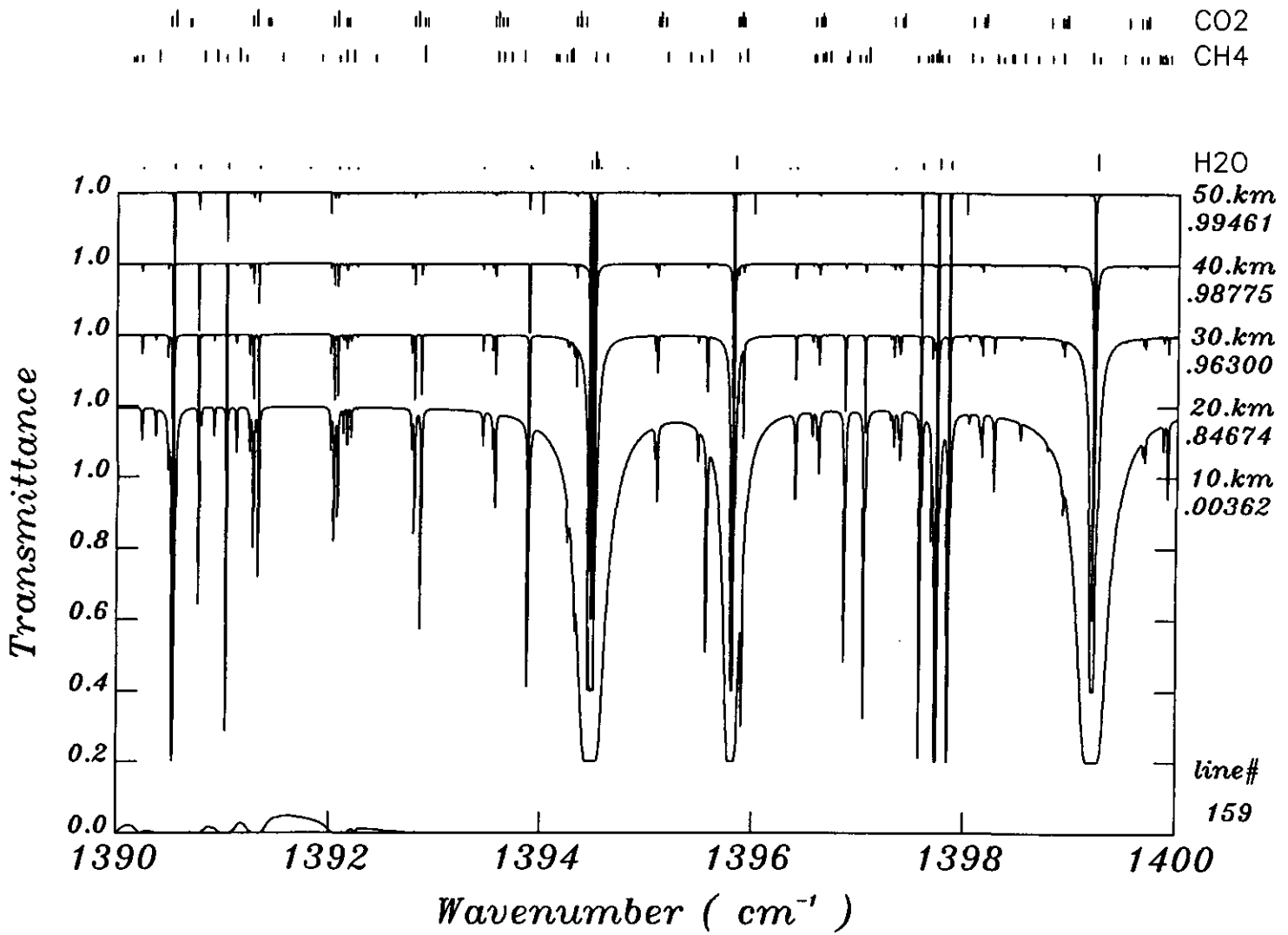

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
0.5
0.0
HN03
1.0000
NO2
1.0000
CO2
0.9702
CH4
0.9310
N20
1.0000
03
1.0000
H20
0.9214
1370
1372
1374
1376
1378
1380
Wavenumber (cm⁻¹)

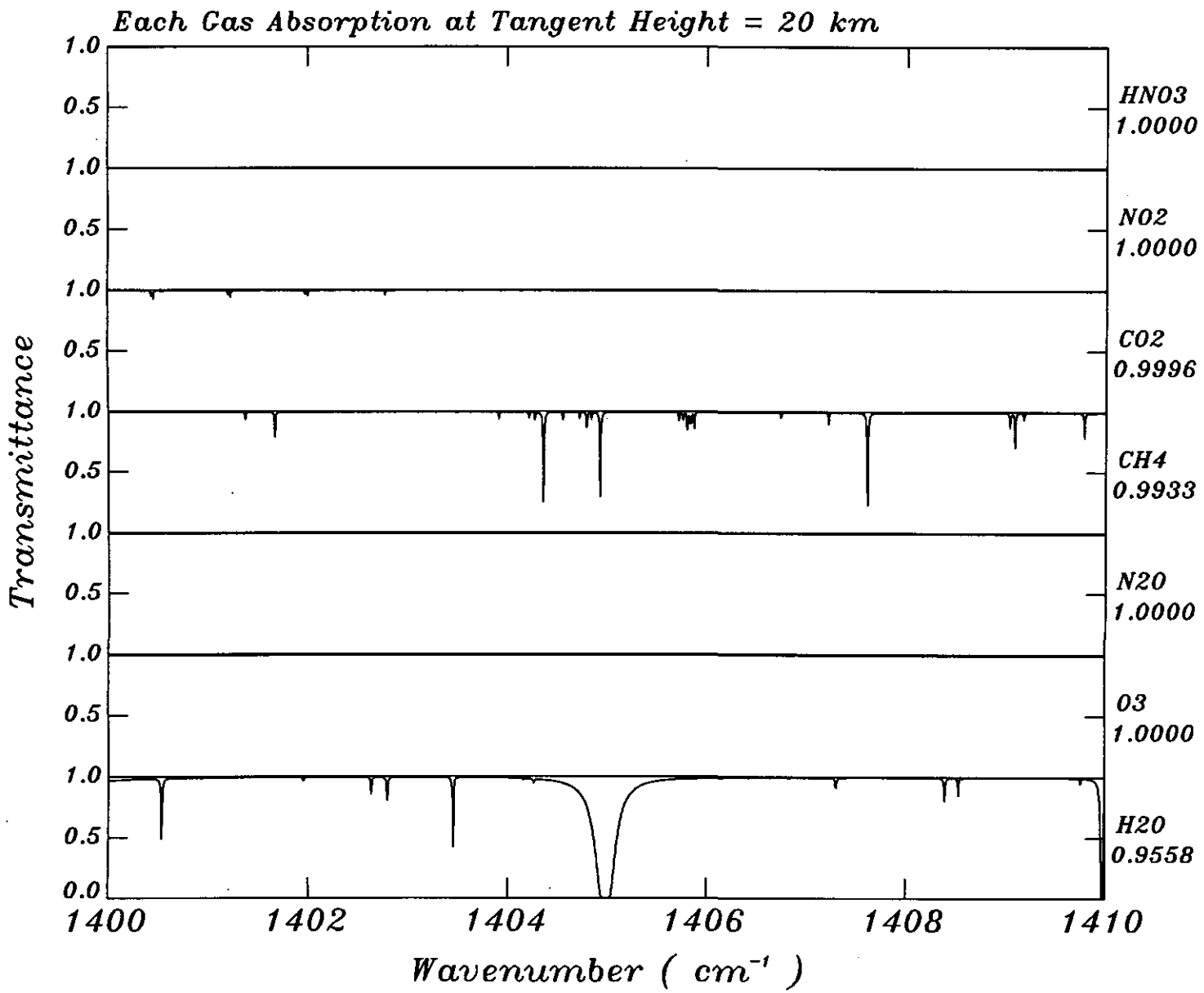

CO2
CH4
H2O
50.km
.99660
40.km
.99016
30.km
.96277
20.km
.82979
10.km
.03142
line#
154
Transmittance
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
1370
1372
1374
1376
1378
1380
Wavenumber (cm⁻¹)

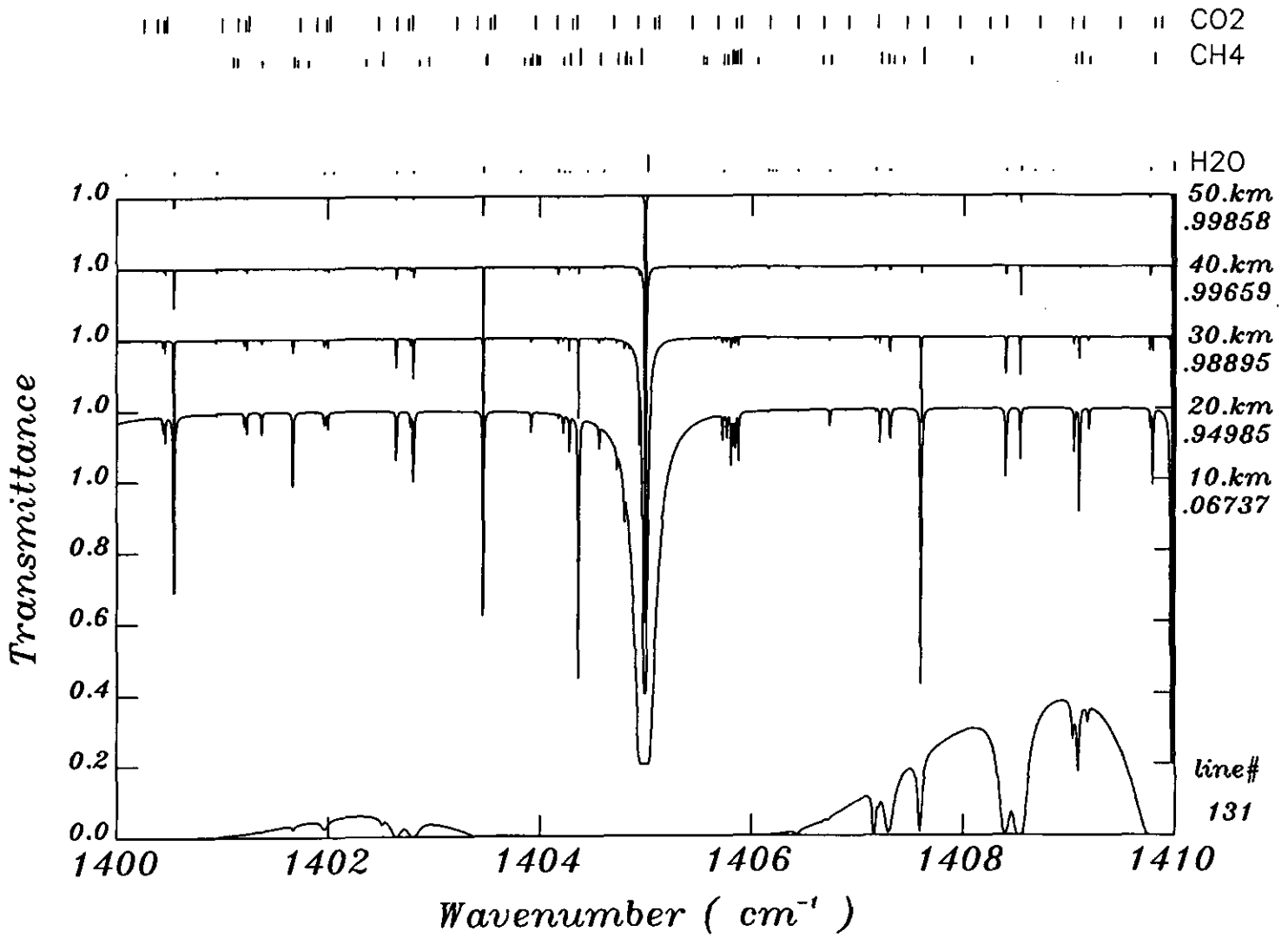

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
0.5
0.0
HNO3
1.0000
NO2
1.0000
CO2
0.9791
CH4
0.9711
N2O
1.0000
O3
1.0000
H2O
0.9436
1380
1382
1384
1386
1388
1390
Wavenumber (cm⁻¹)

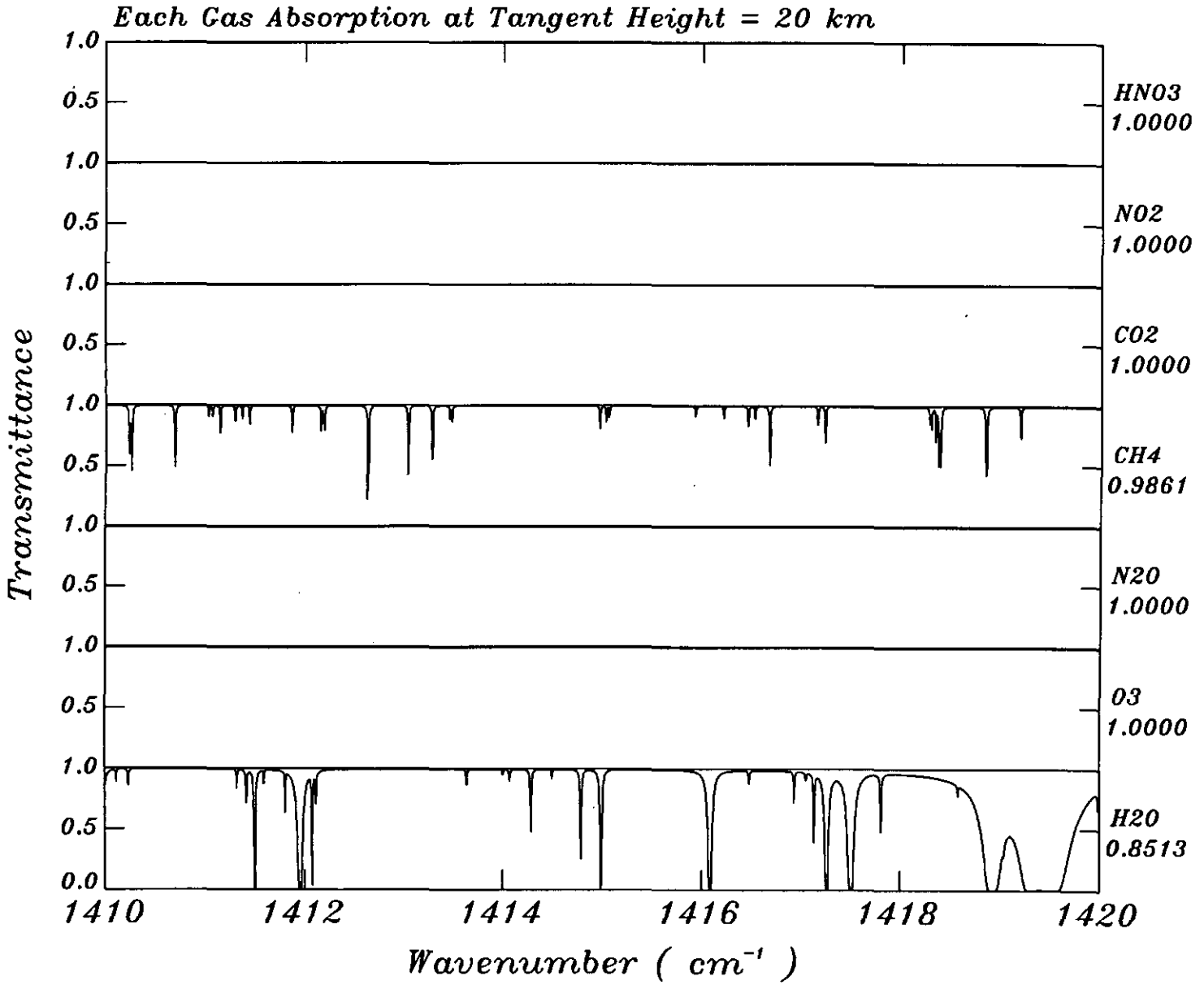

CO2
CH4
H2O
50.km
.99704
40.km
.99314
30.km
.97757
20.km
.89851
10.km
.12143
line#
146
Transmittance
1.0
0.8
0.6
0.4
0.2
0.0
1380
1382
1384
1386
1388
1390
Wavenumber (cm⁻¹)

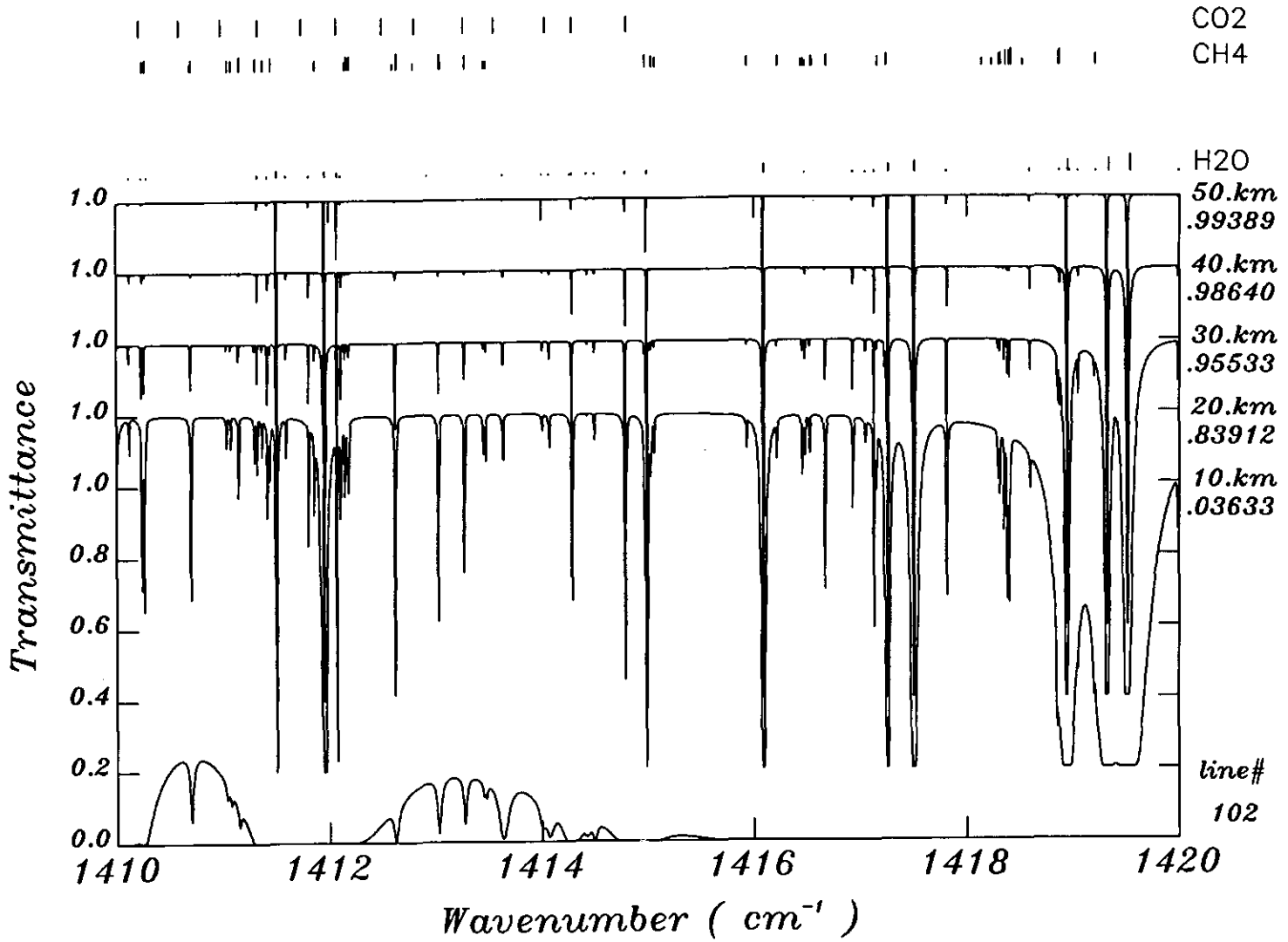

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
0.5
0.0
HN03
1.0000
NO2
1.0000
CO2
0.9935
CH4
0.9896
N20
1.0000
03
1.0000
H20
0.8603
1390
1392
1394
1396
1398
1400
Wavenumber (cm⁻¹)

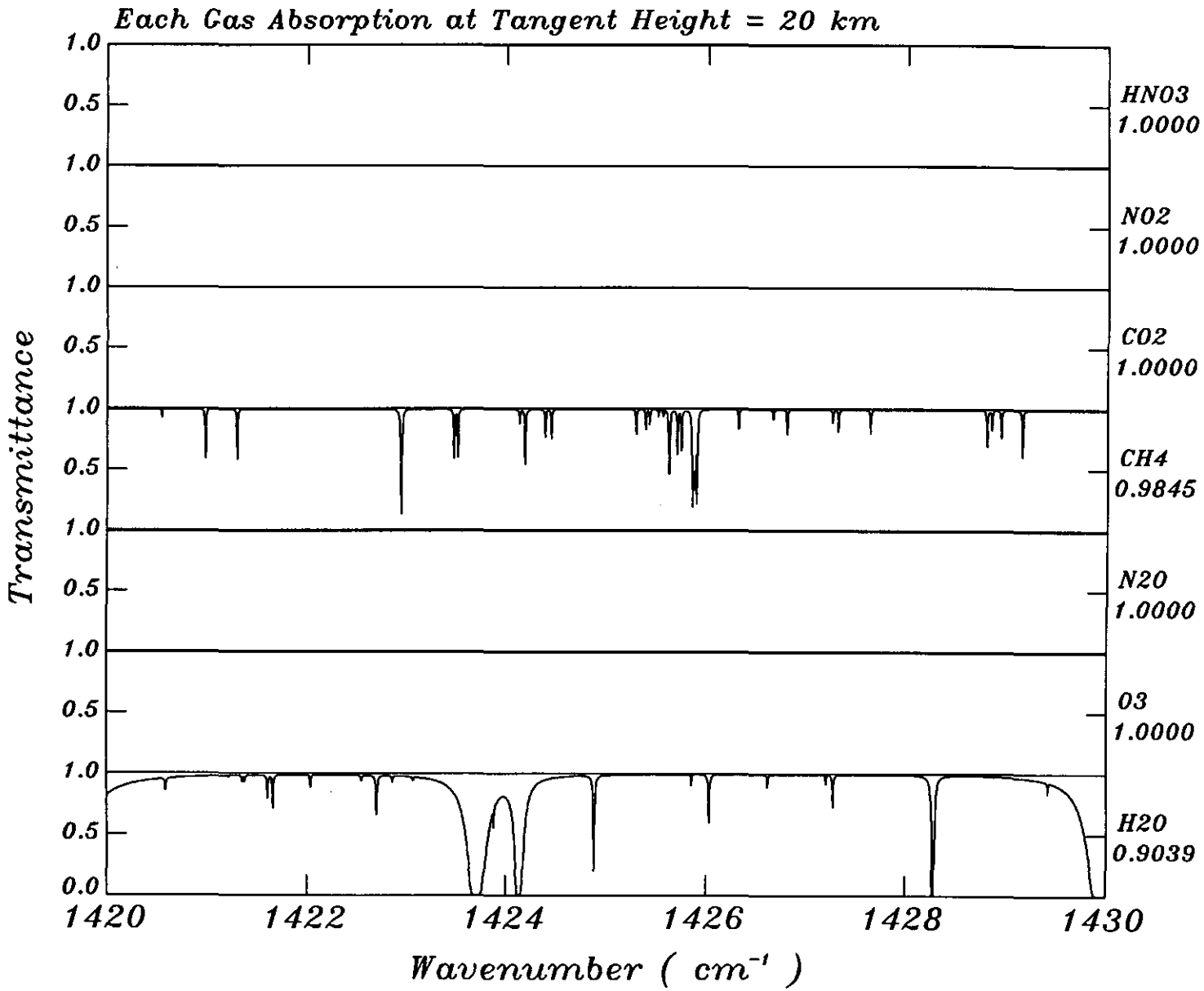

CO2
CH4
H2O
50.km
.99461
40.km
.98775
30.km
.96300
20.km
.84674
10.km
.00362
line#
159
1.0
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
Transmittance
1390
1392
1394
1396
1398
1400
Wavenumber (cm⁻¹)

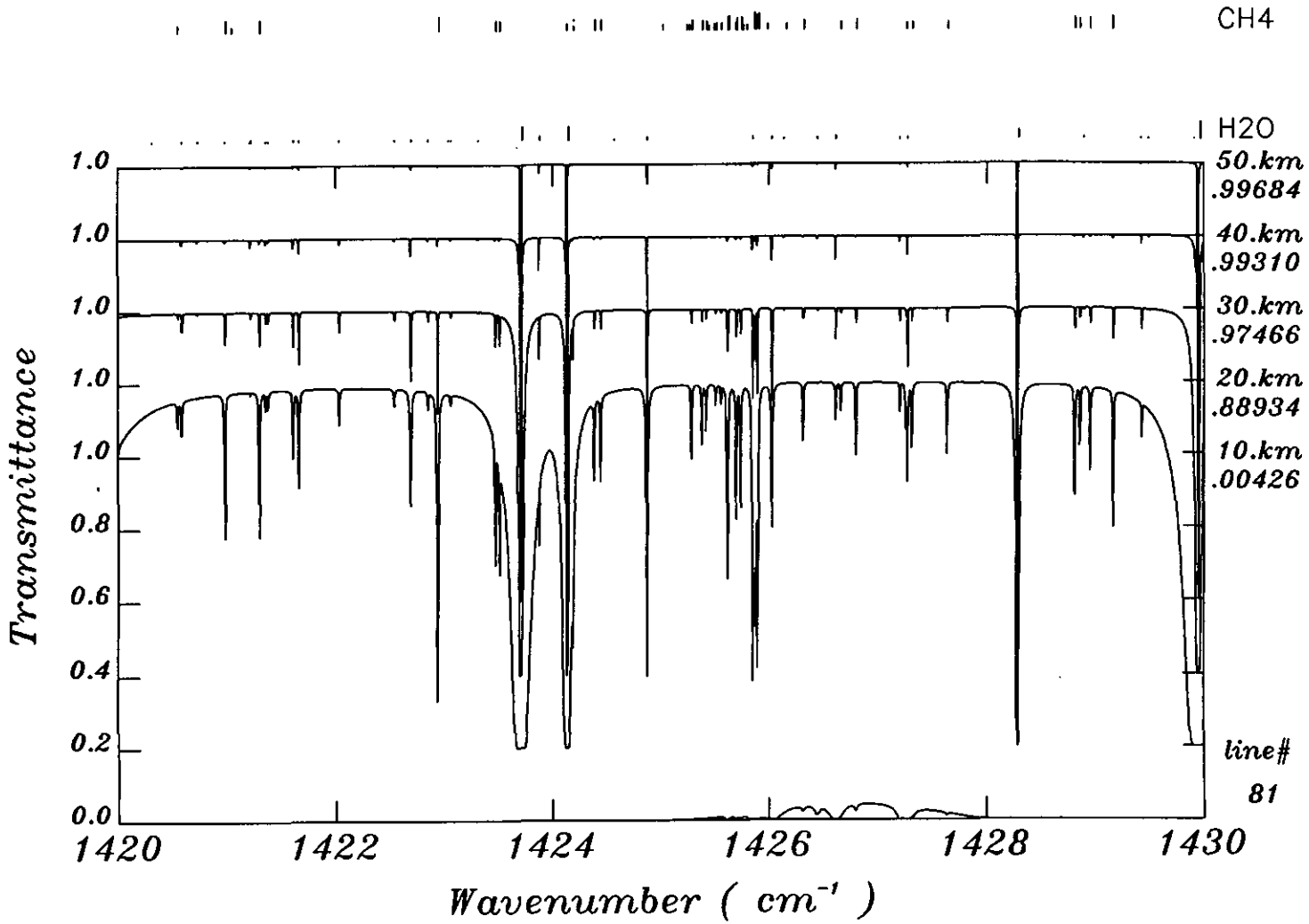

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
0.5
0.0
HN03
1.0000
NO2
1.0000
CO2
0.9996
CH4
0.9933
N20
1.0000
03
1.0000
H20
0.9558
1400
1402
1404
1406
1408
1410
Wavenumber (cm⁻¹)

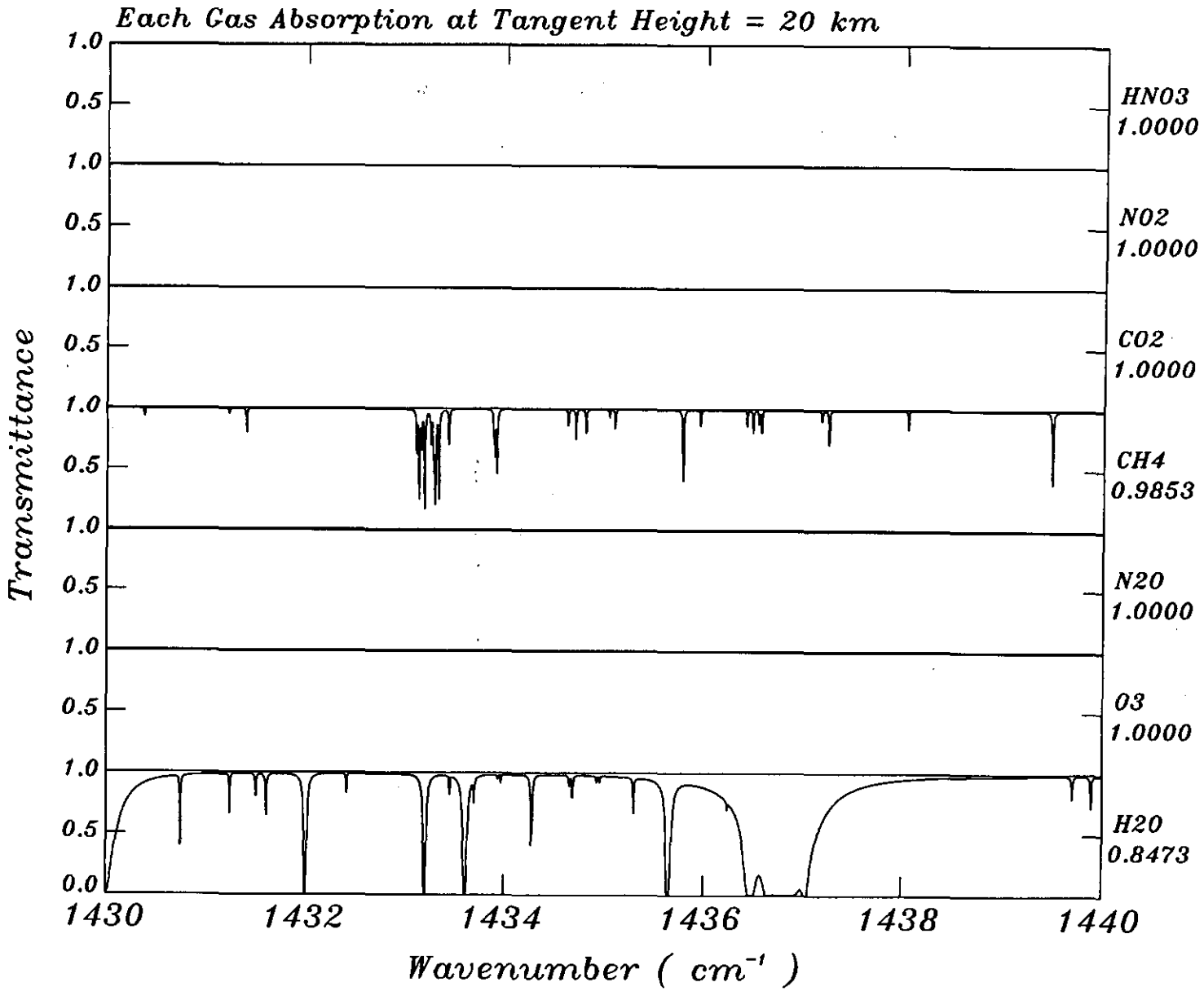

CO2
CH4
H2O
50.km
.99858
40.km
.99659
30.km
.98895
20.km
.94985
10.km
.06737
line#
131
Transmittance
1.0
0.8
0.6
0.4
0.2
0.0
1400
1402
1404
1406
1408
1410
Wavenumber (cm⁻¹)

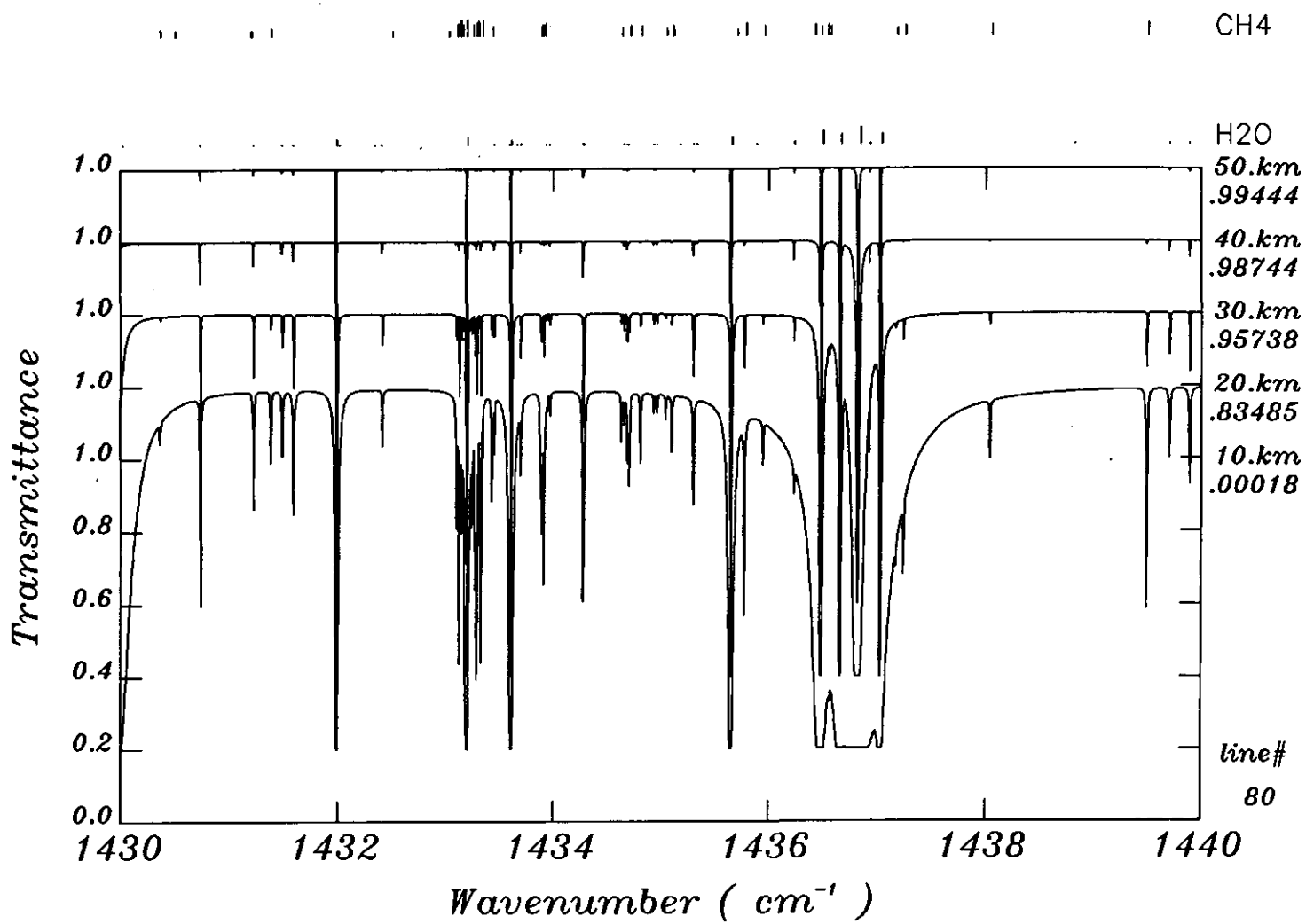

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
0.5
0.0
HNO3
1.0000
NO2
1.0000
CO2
1.0000
CH4
0.9861
N2O
1.0000
O3
1.0000
H2O
0.8513
1410
1412
1414
1416
1418
1420
Wavenumber (cm⁻¹)

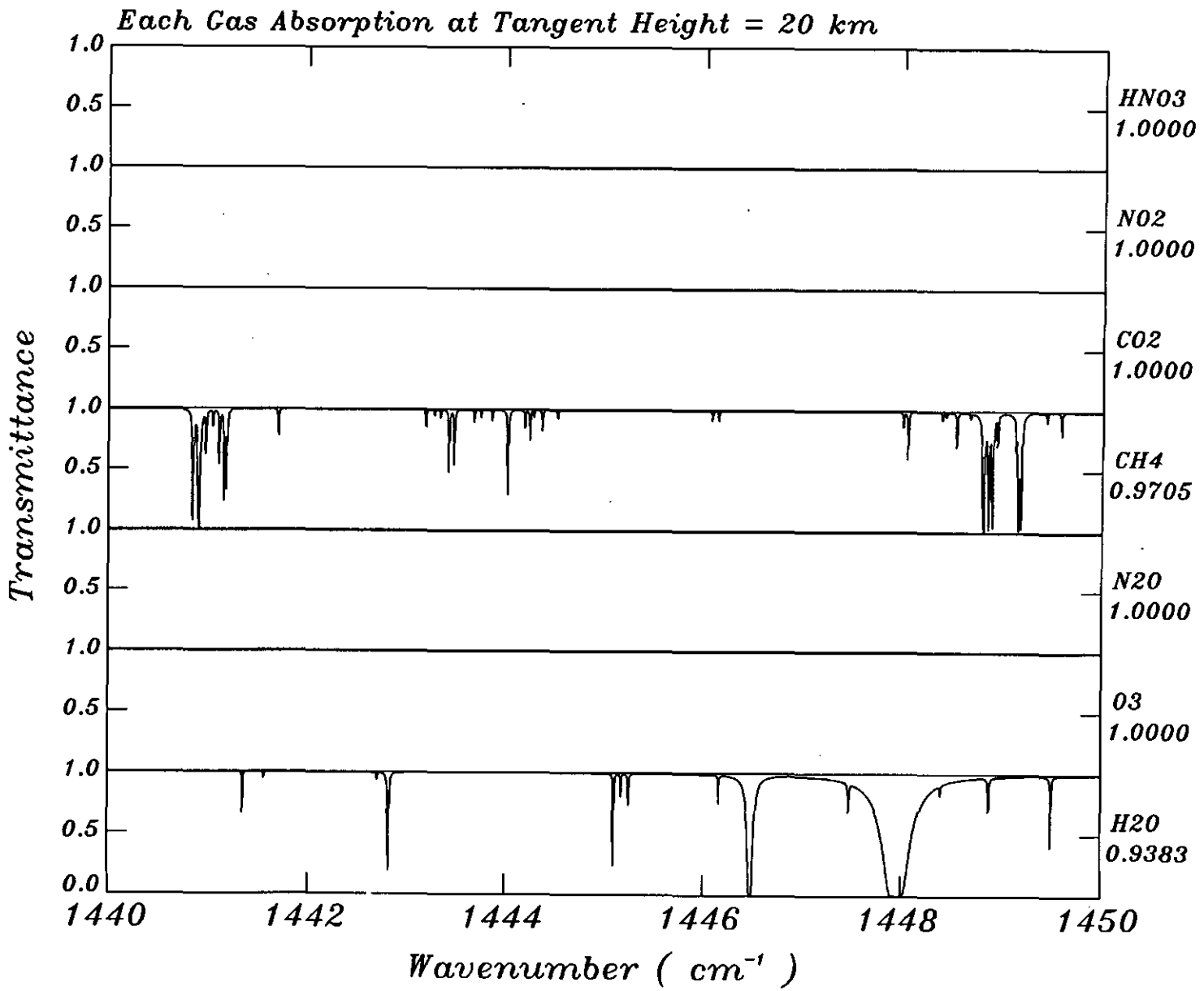

CO2
CH4
H2O
50.km
.99389
40.km
.98640
30.km
.95533
20.km
.83912
10.km
.03633
line#
102
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
Transmittance
1410
1412
1414
1416
1418
1420
Wavenumber (cm⁻¹)

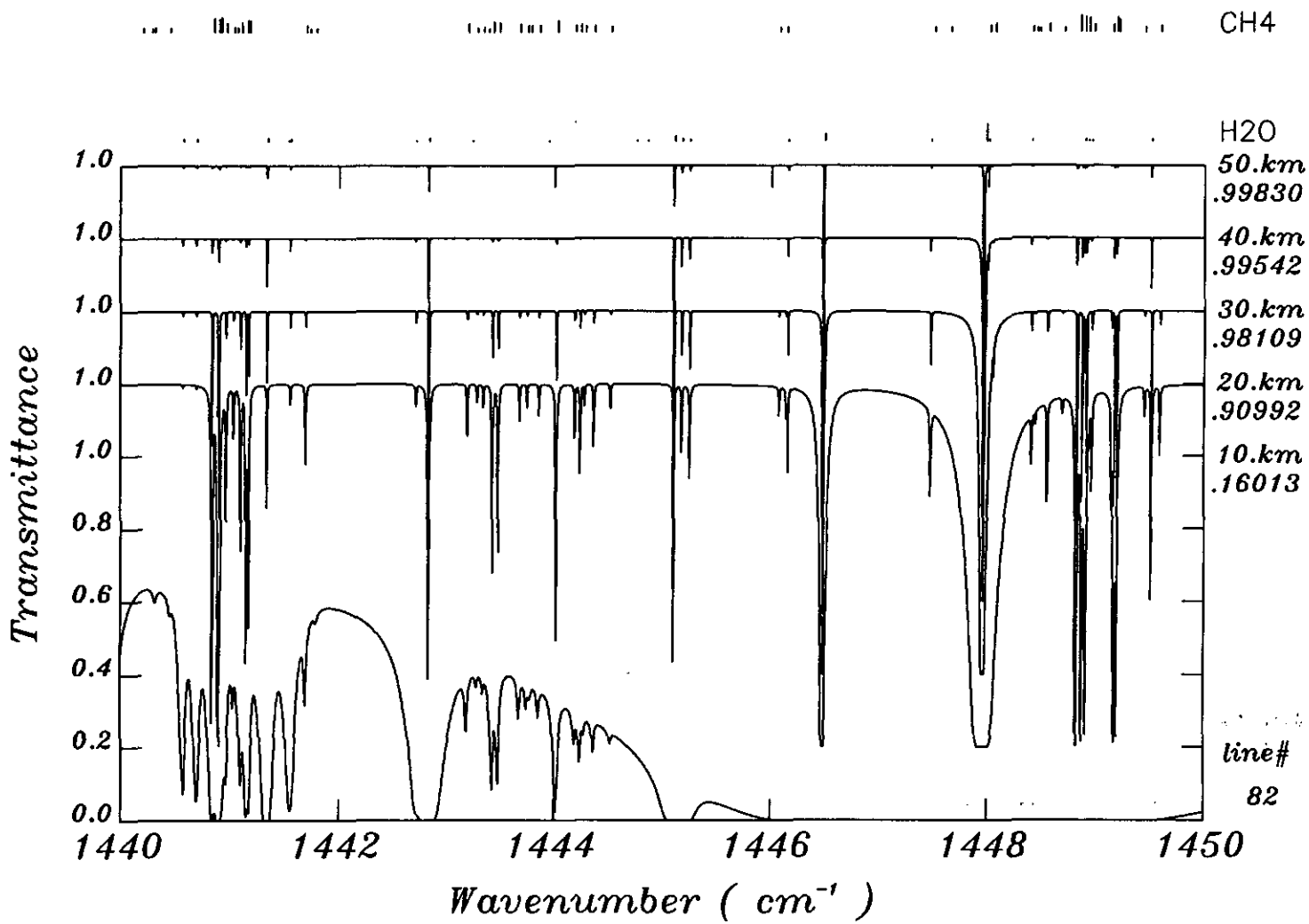

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
0.0
HNO3
1.0000
NO2
1.0000
CO2
1.0000
CH4
0.9845
N2O
1.0000
O3
1.0000
H2O
0.9039
1420
1422
1424
1426
1428
1430
Wavenumber (cm⁻¹)

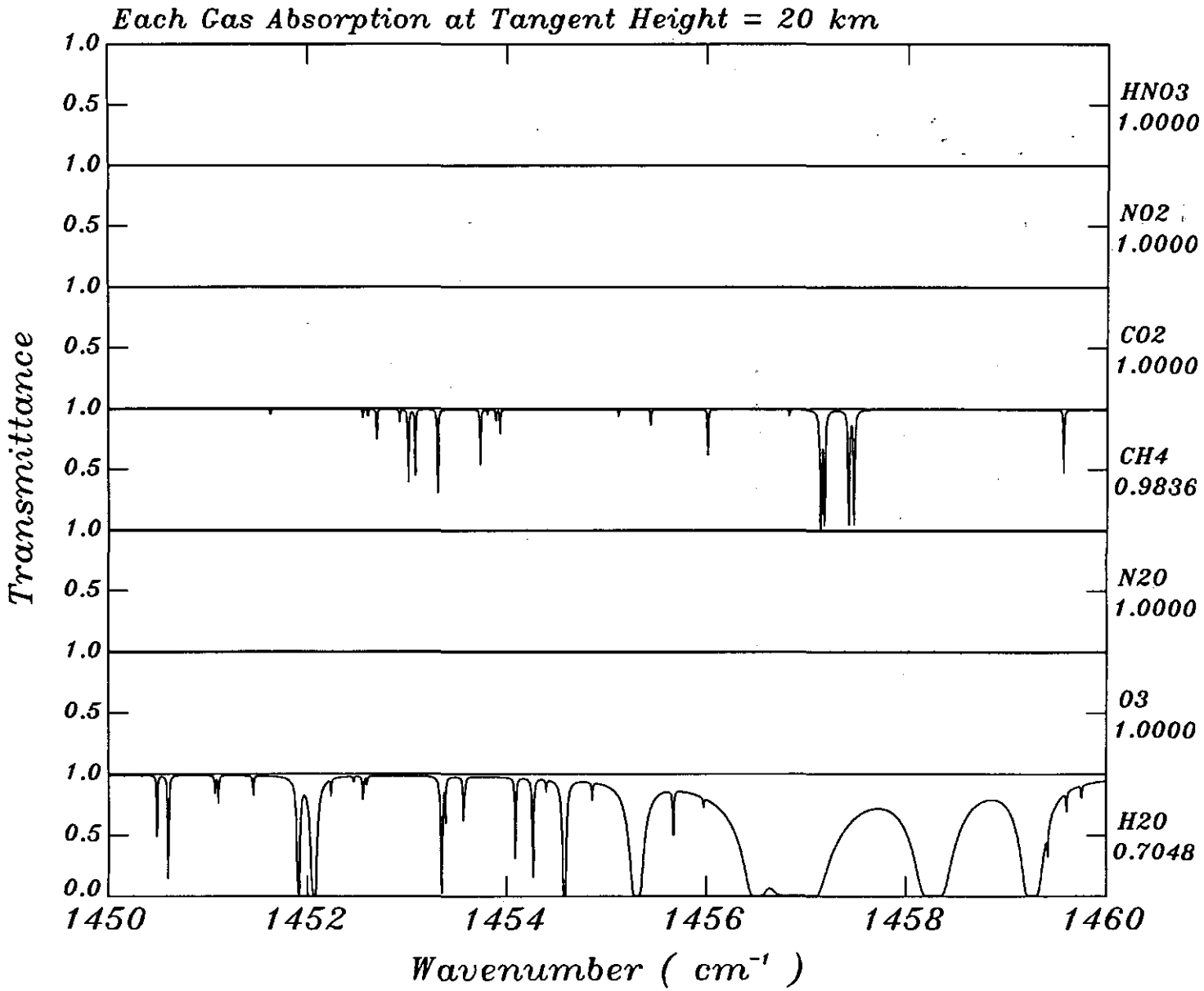

CH4
H2O
50.km
.99684
40.km
.99310
30.km
.97466
20.km
.88934
10.km
.00426
line#
81
Transmittance
1.0
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
1420
1422
1424
1426
1428
1430
Wavenumber (cm⁻¹)

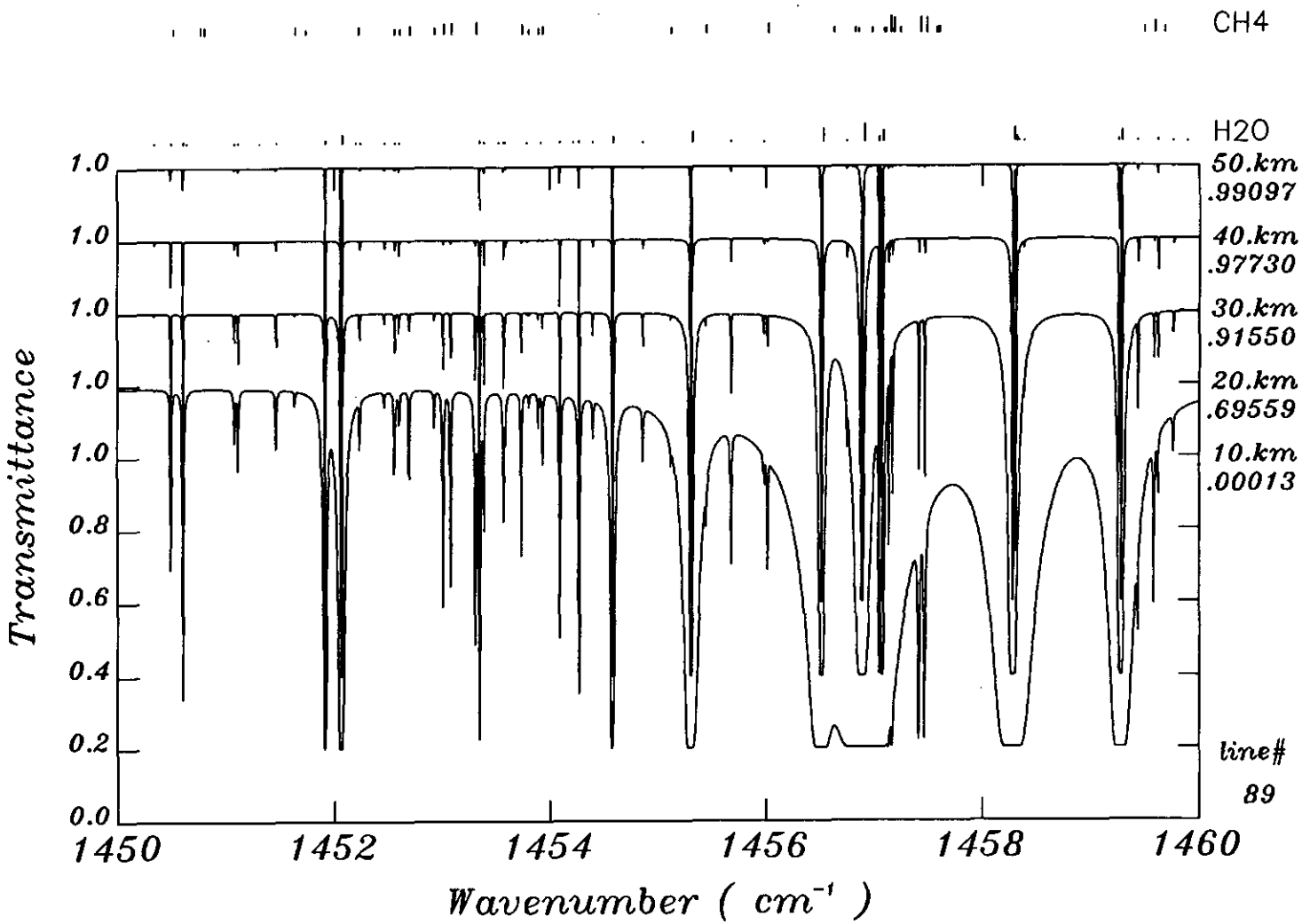

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
0.5
HN03
1.0000
N02
1.0000
C02
1.0000
CH4
0.9853
N20
1.0000
03
1.0000
H20
0.8473
0.0
1430
1432
1434
1436
1438
1440
Wavenumber (cm⁻¹)

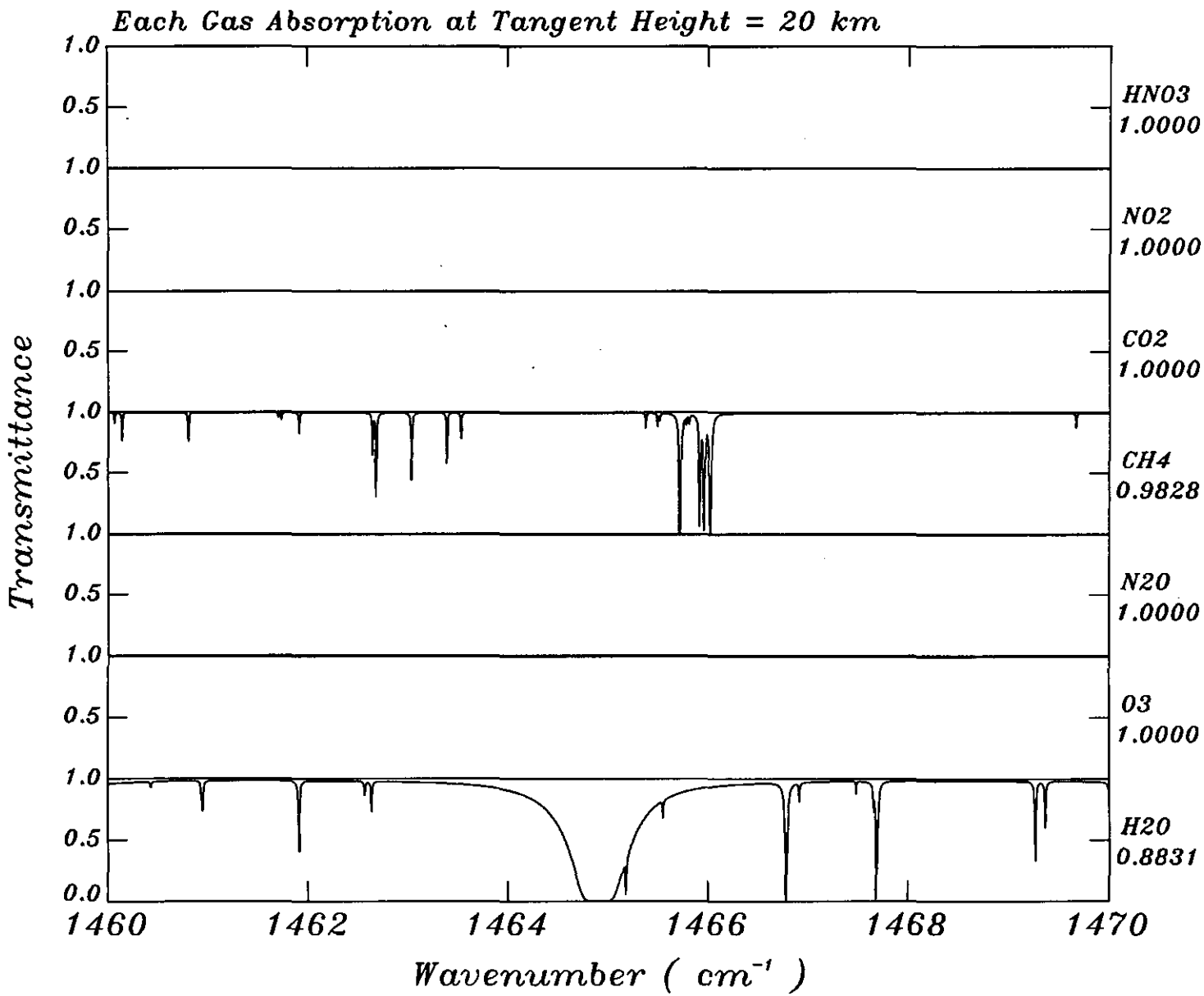

CH4
H2O
50.km
.99444
40.km
.98744
30.km
.95738
20.km
.83485
10.km
.00018
line#
80
Transmittance
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
1430
1432
1434
1436
1438
1440
Wavenumber (cm⁻¹)

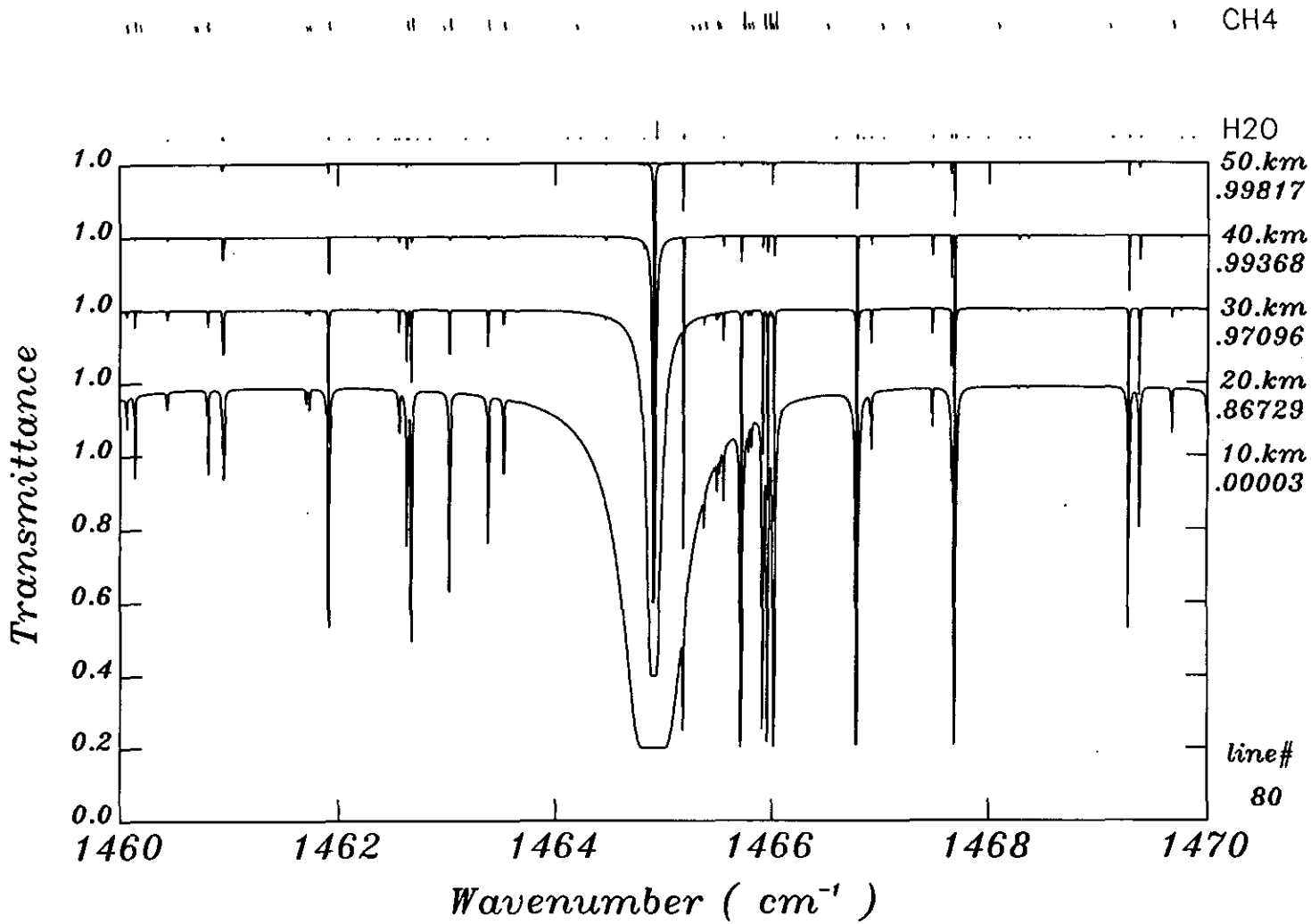

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
0.5
0.0
HNO3
1.0000
NO2
1.0000
CO2
1.0000
CH4
0.9705
N2O
1.0000
O3
1.0000
H2O
0.9383
1440
1442
1444
1446
1448
1450
Wavenumber (cm⁻¹)

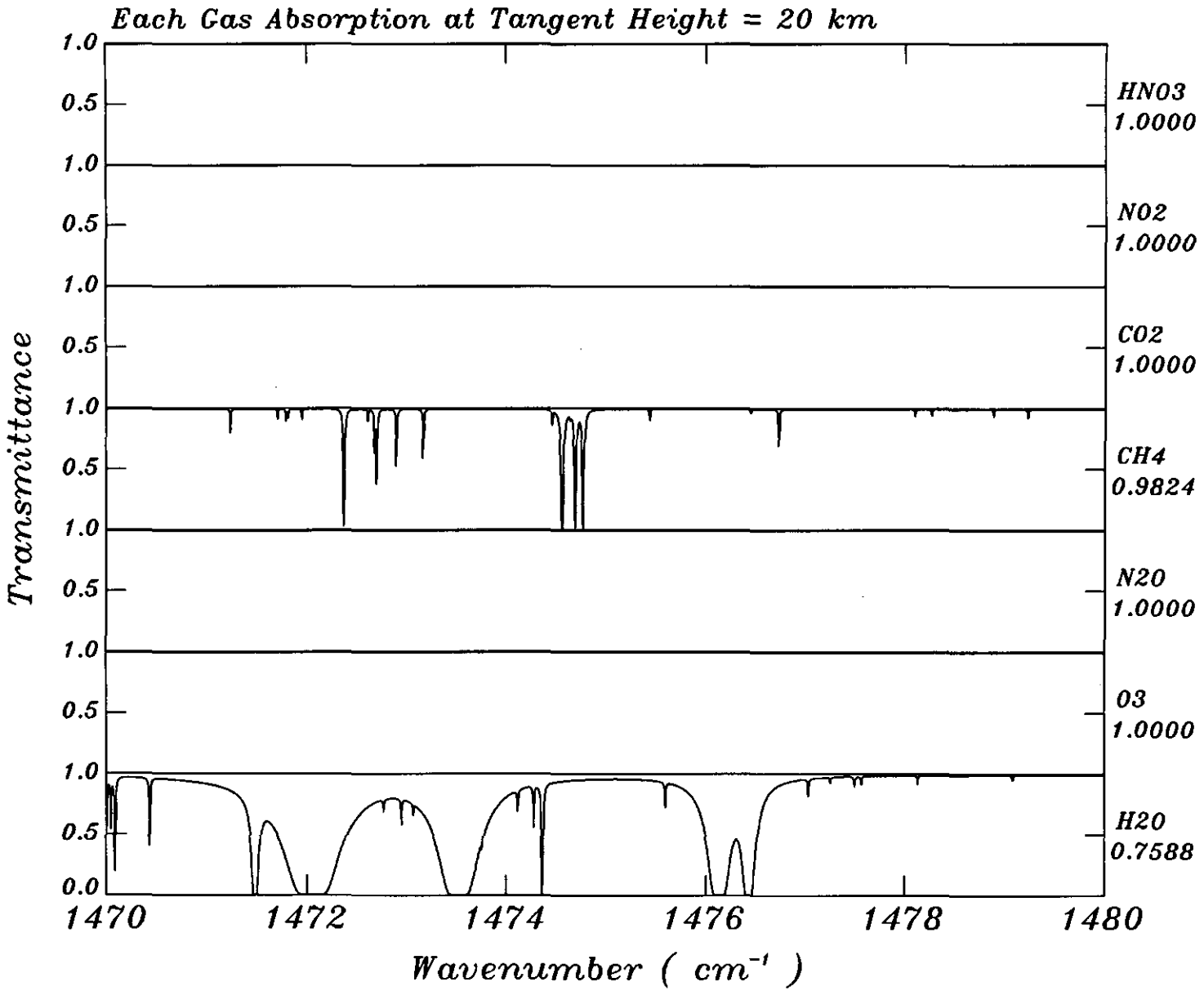

CH4
H2O
50.km
.99830
40.km
.99542
30.km
.98109
20.km
.90992
10.km
.16013
line#
82
Transmittance
1.0
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
1440
1442
1444
1446
1448
1450
Wavenumber (cm⁻¹)

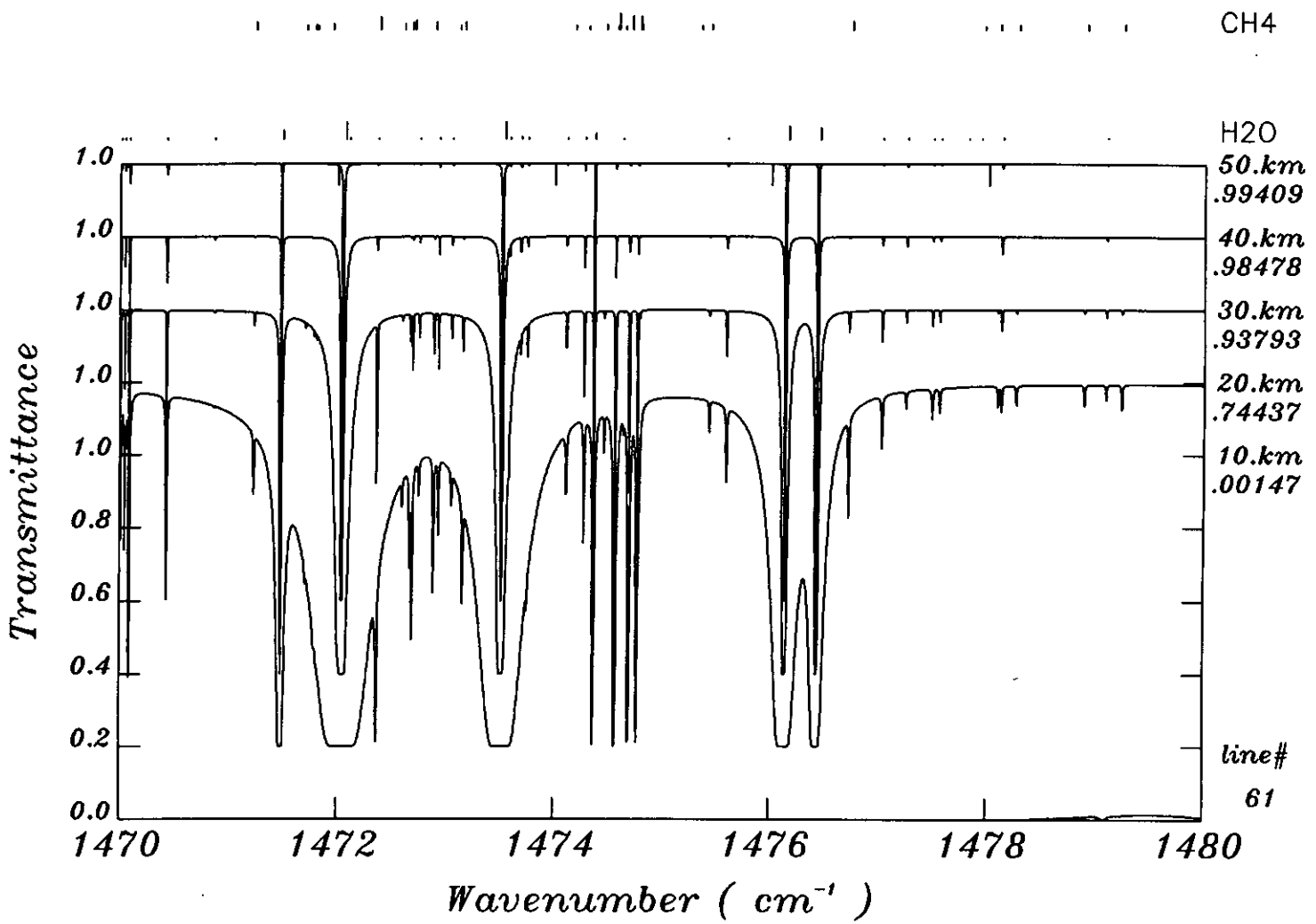

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
0.0
HNO3
1.0000
NO2
1.0000
CO2
1.0000
CH4
0.9836
N2O
1.0000
O3
1.0000
H2O
0.7048
1450
1452
1454
1456
1458
1460
Wavenumber (cm⁻¹)

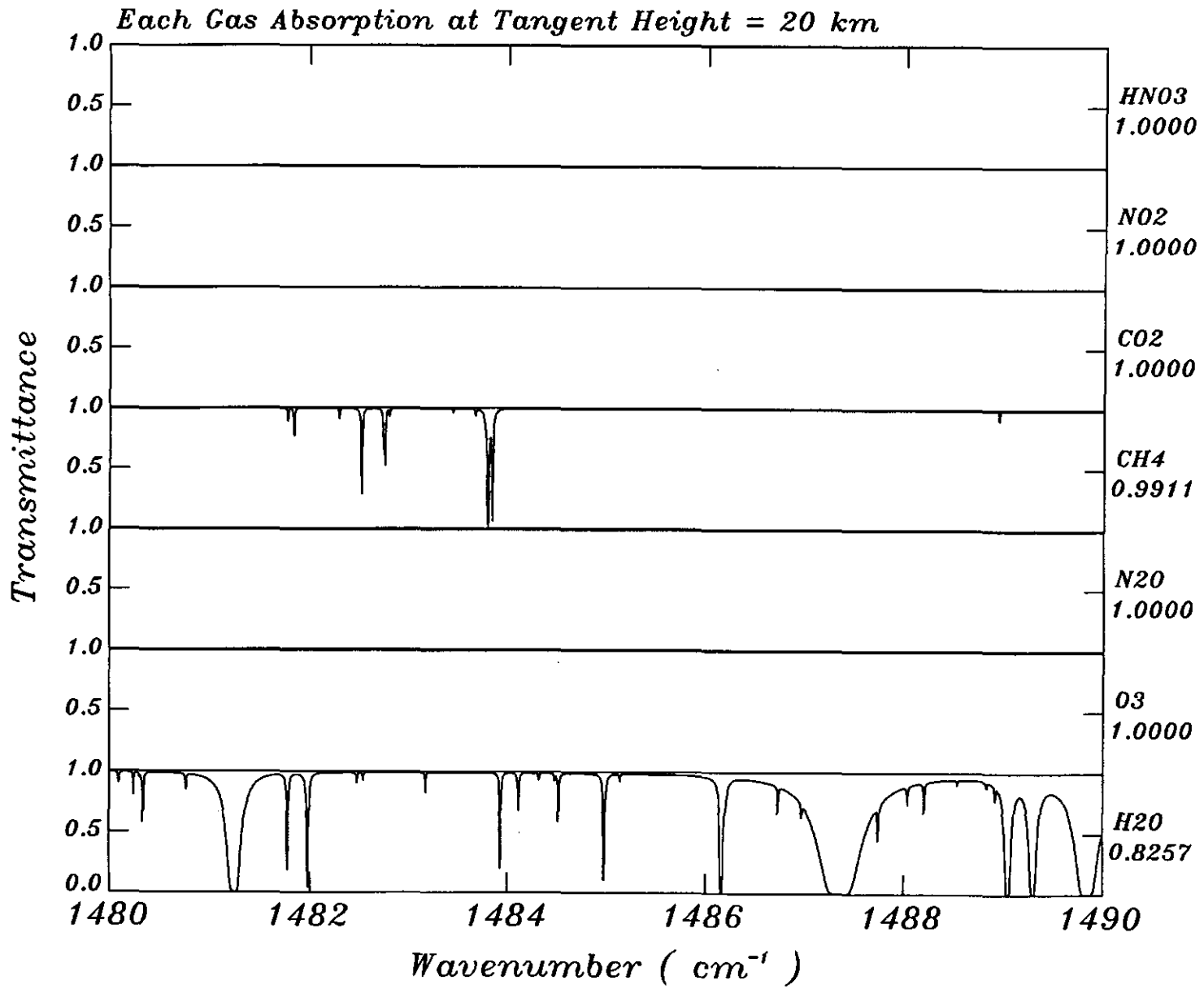

CH4
H2O
50.km
.99097
40.km
.97730
30.km
.91550
20.km
.69559
10.km
.00013
line#
89
Transmittance
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
1450
1452
1454
1456
1458
1460
Wavenumber (cm⁻¹)

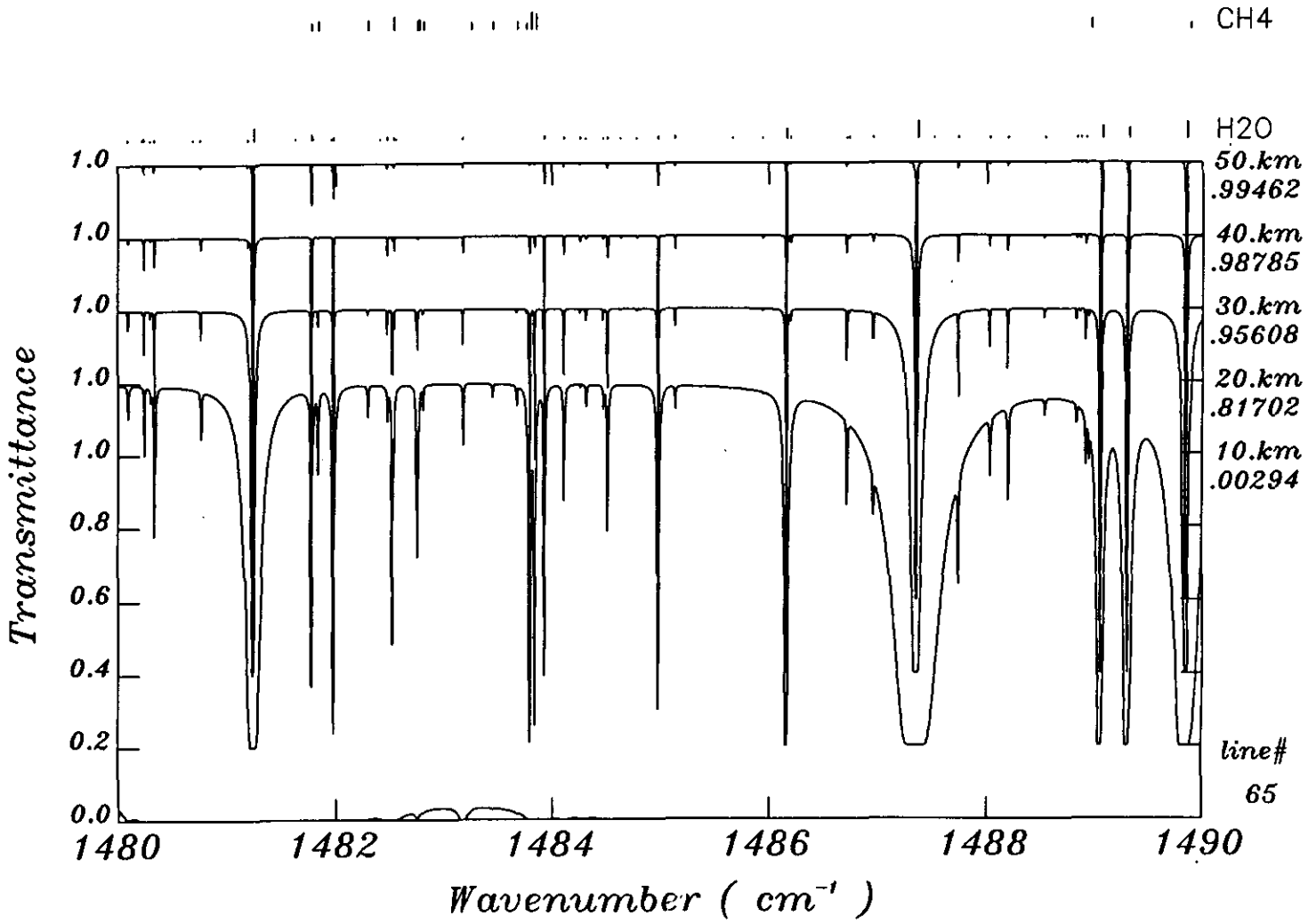

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
0.5
0.0
HN03
1.0000
NO2
1.0000
CO2
1.0000
CH4
0.9828
N20
1.0000
03
1.0000
H20
0.8831
1460
1462
1464
1466
1468
1470
Wavenumber (cm⁻¹)

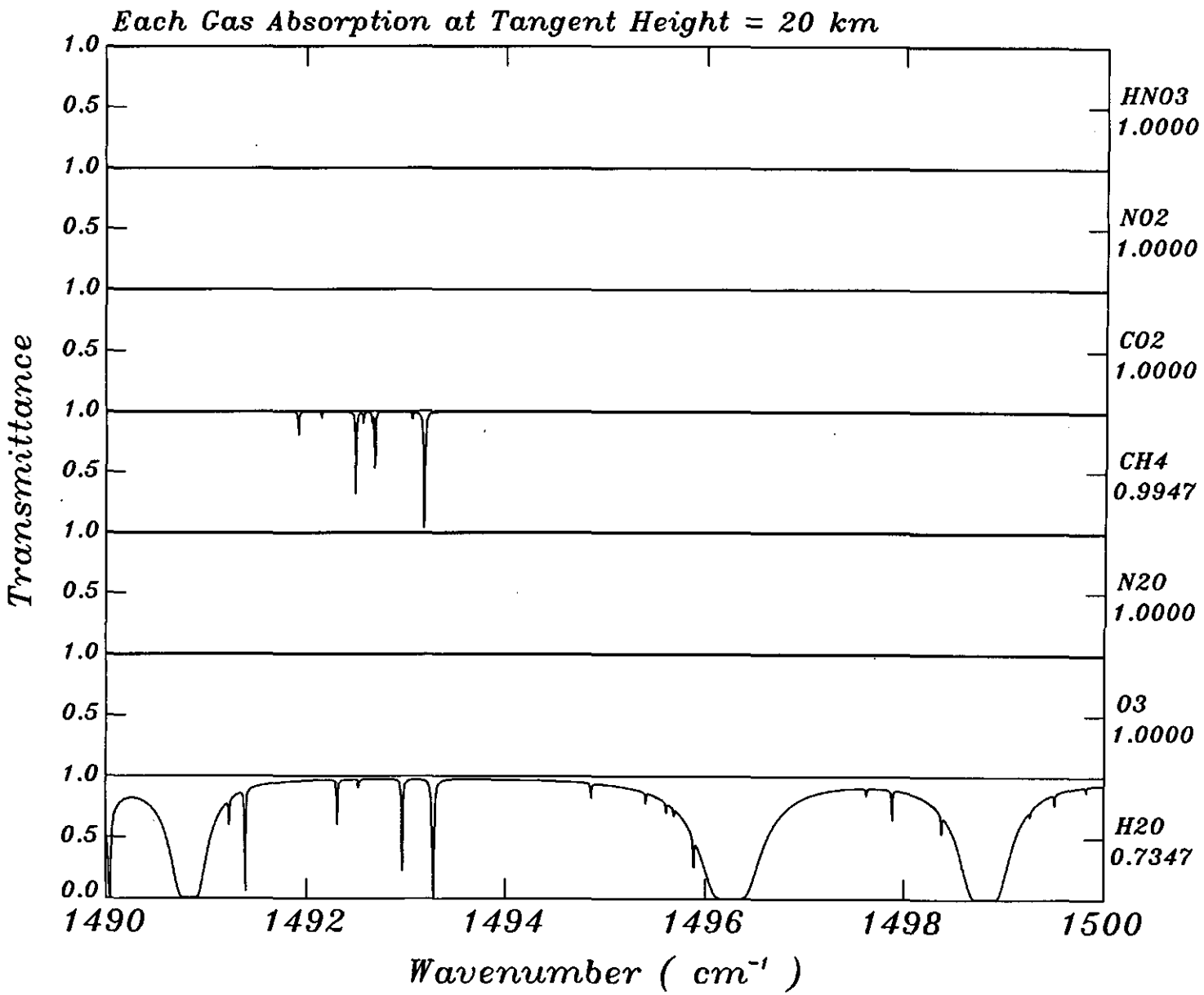

CH4
H2O
50.km
.99817
40.km
.99368
30.km
.97096
20.km
.86729
10.km
.00003
line#
80
1.0
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
Transmittance
1460
1462
1464
1466
1468
1470
Wavenumber (cm⁻¹)

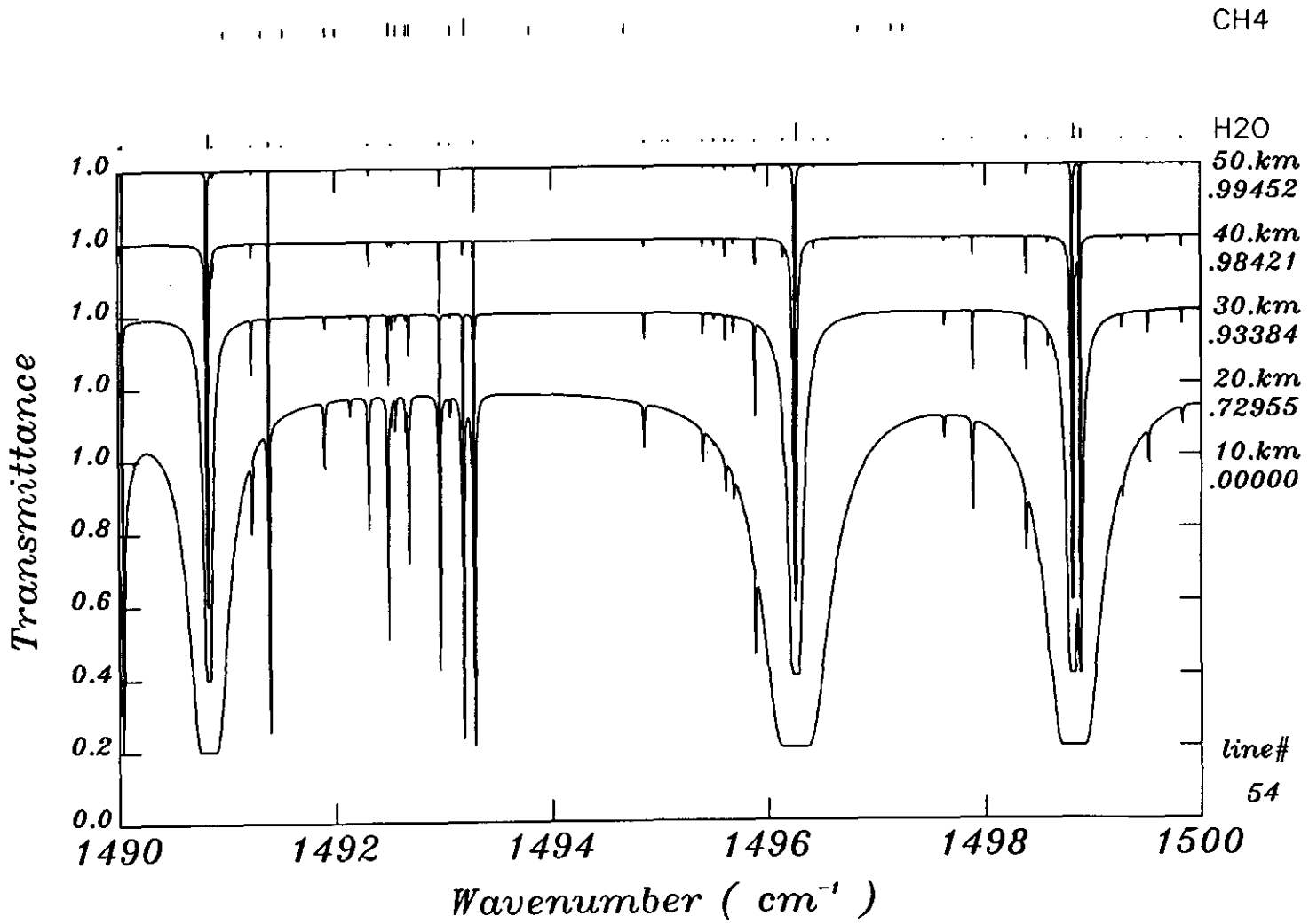

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
0.5
0.0
HN03
1.0000
NO2
1.0000
CO2
1.0000
CH4
0.9824
N20
1.0000
03
1.0000
H20
0.7588
1470
1472
1474
1476
1478
1480
Wavenumber (cm⁻¹)

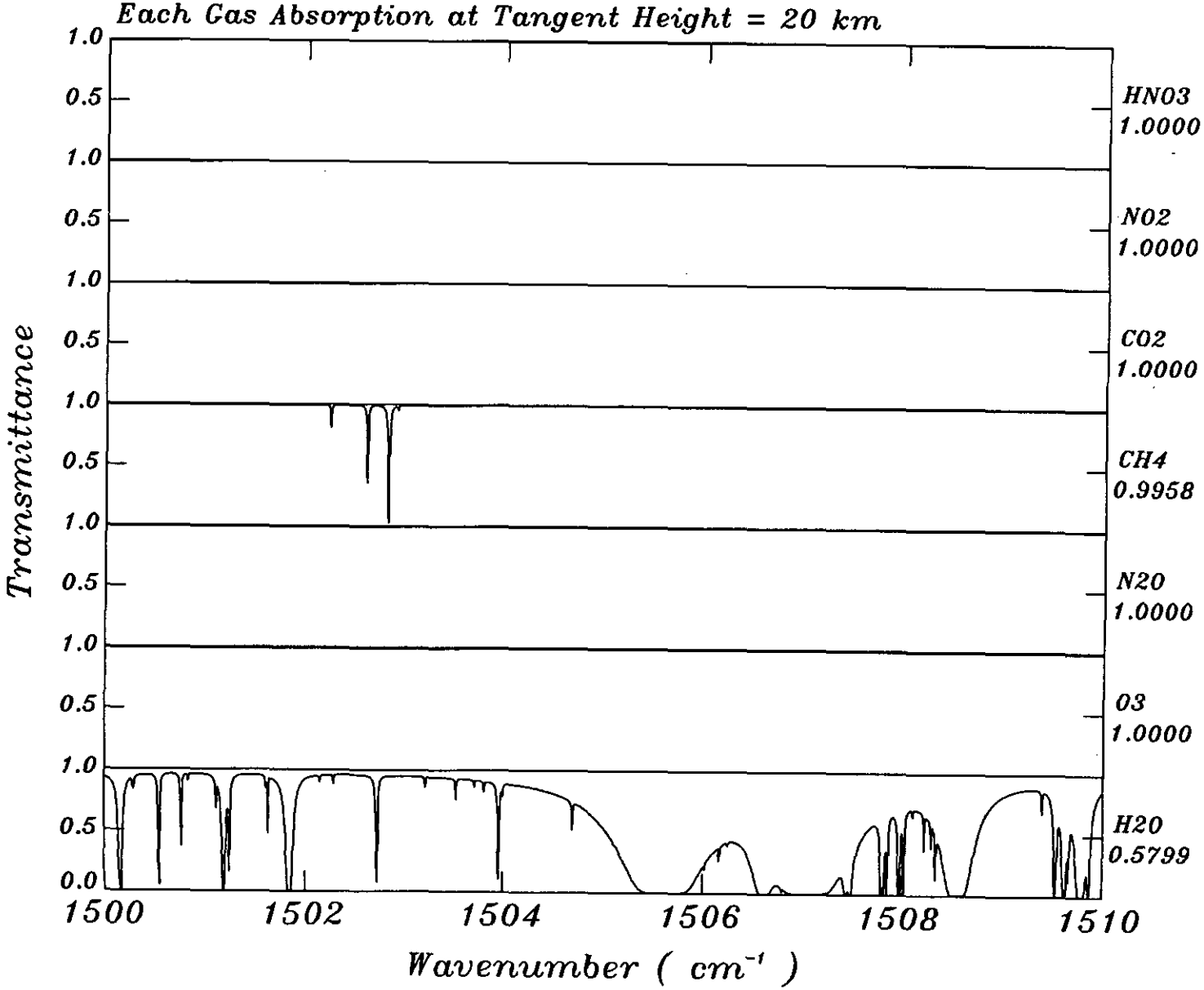

CH4
H2O
50.km
.99409
40.km
.98478
30.km
.93793
20.km
.74437
10.km
.00147
line#
61
Transmittance
1.0
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
1470
1472
1474
1476
1478
1480
Wavenumber (cm⁻¹)

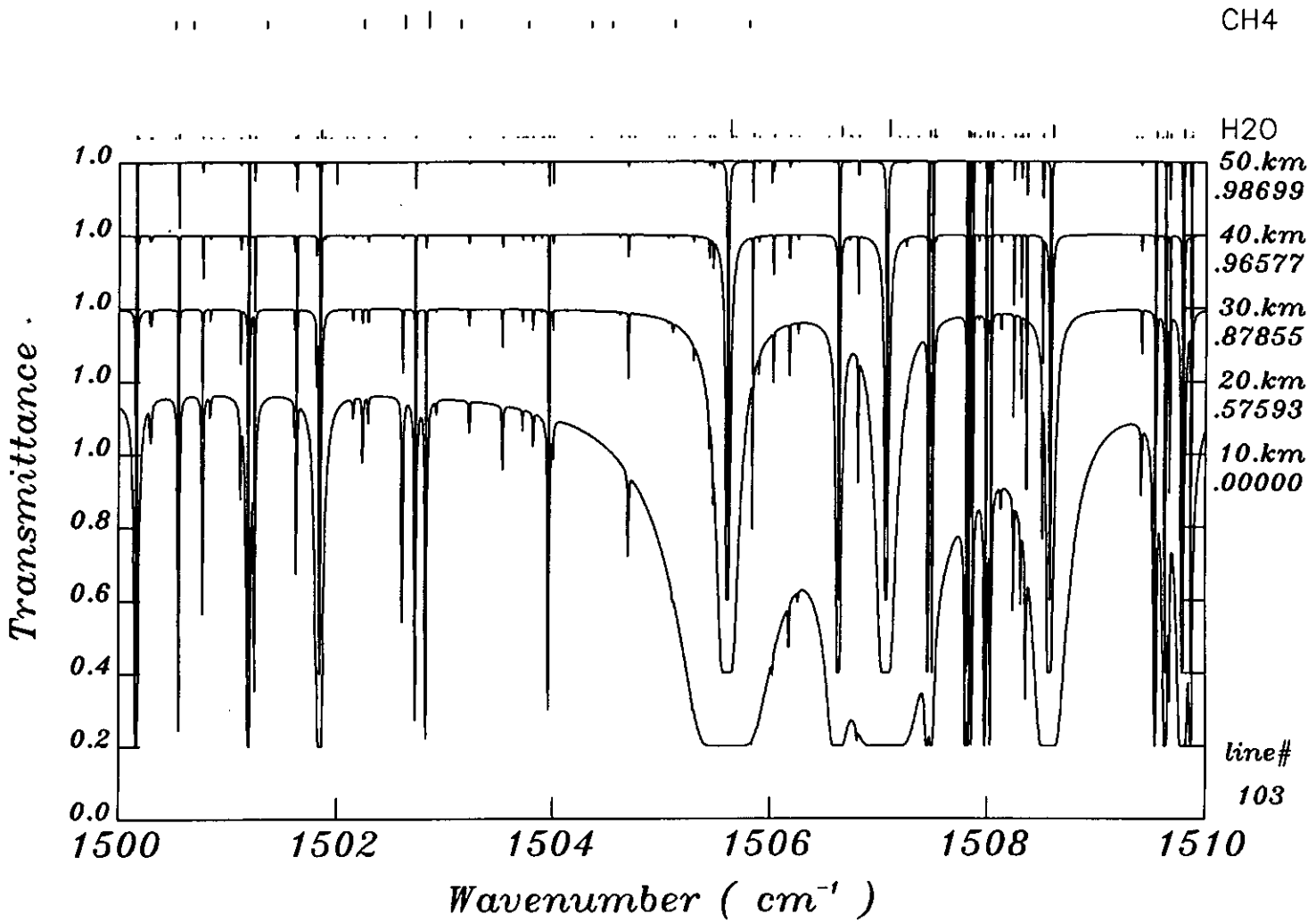

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
0.5
0.0
HN03
1.0000
NO2
1.0000
CO2
1.0000
CH4
0.9911
N20
1.0000
03
1.0000
H20
0.8257
1480
1482
1484
1486
1488
1490
Wavenumber (cm-1)

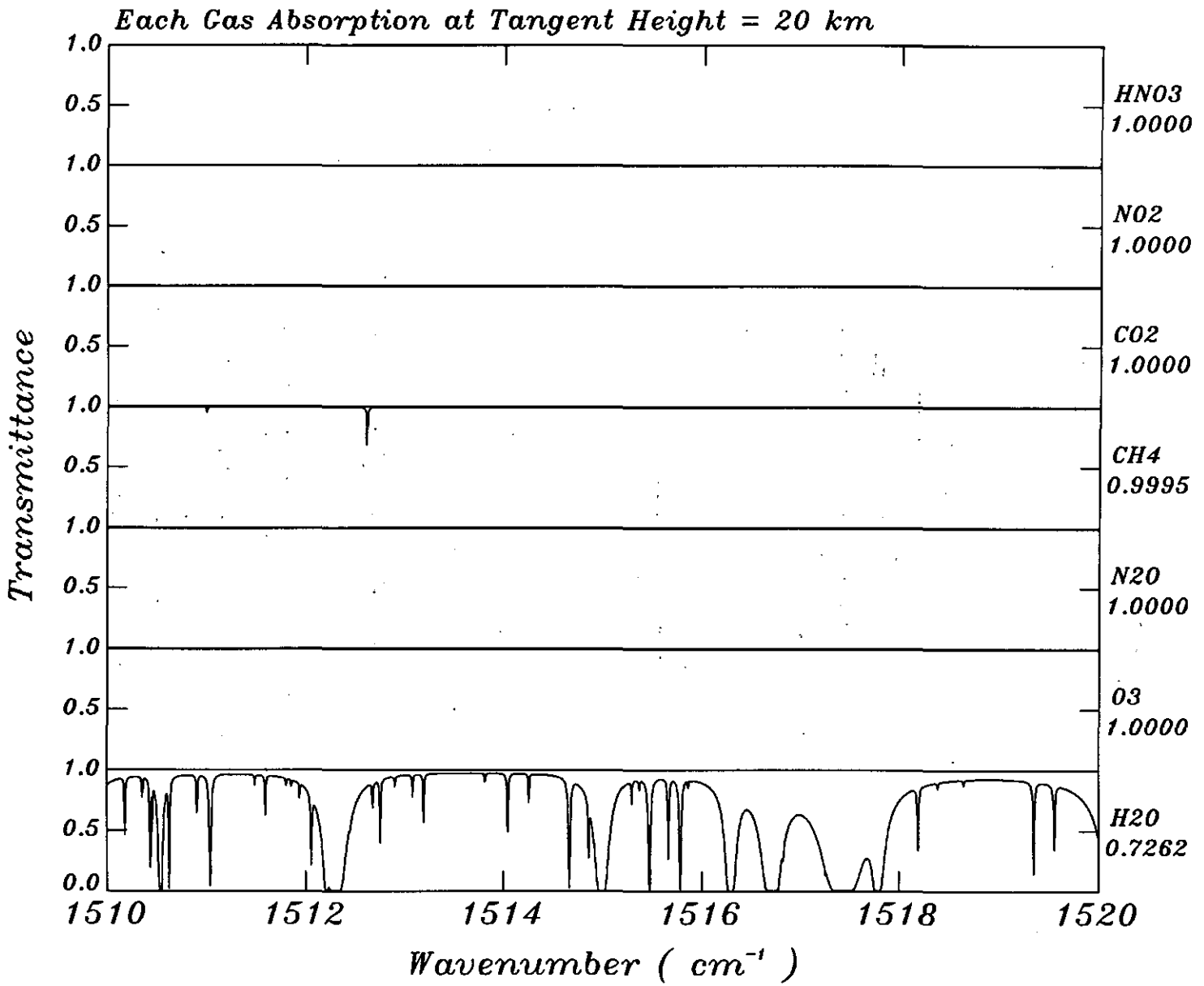

CH4
H2O
50.km
.99462
40.km
.98785
30.km
.95608
20.km
.81702
10.km
.00294
line#
65
Transmittance
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
1480
1482
1484
1486
1488
1490
Wavenumber (cm⁻¹)

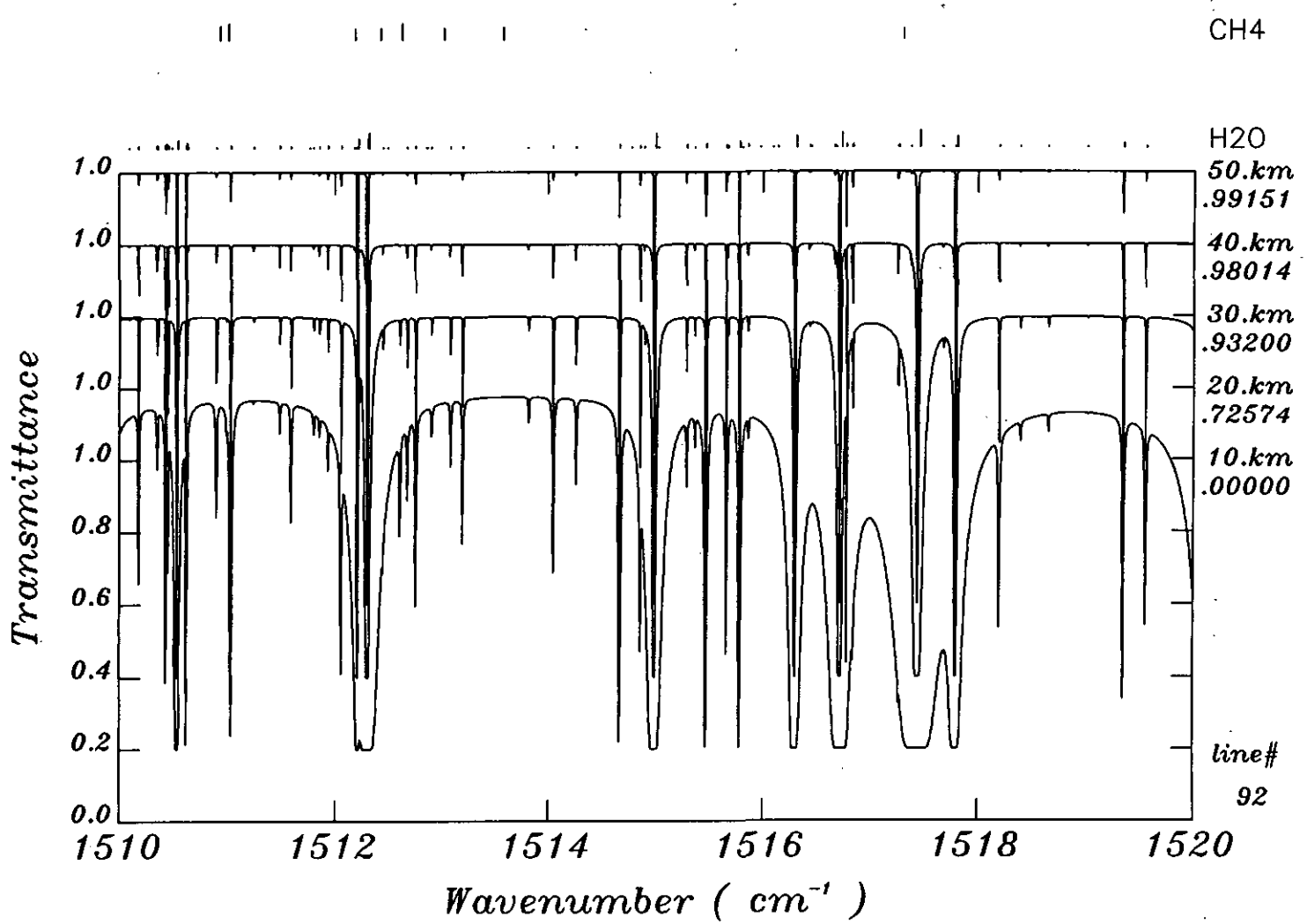

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
0.5
0.0
HNO3
1.0000
NO2
1.0000
CO2
1.0000
CH4
0.9947
N2O
1.0000
O3
1.0000
H2O
0.7347
1490
1492
1494
1496
1498
1500
Wavenumber (cm⁻¹)

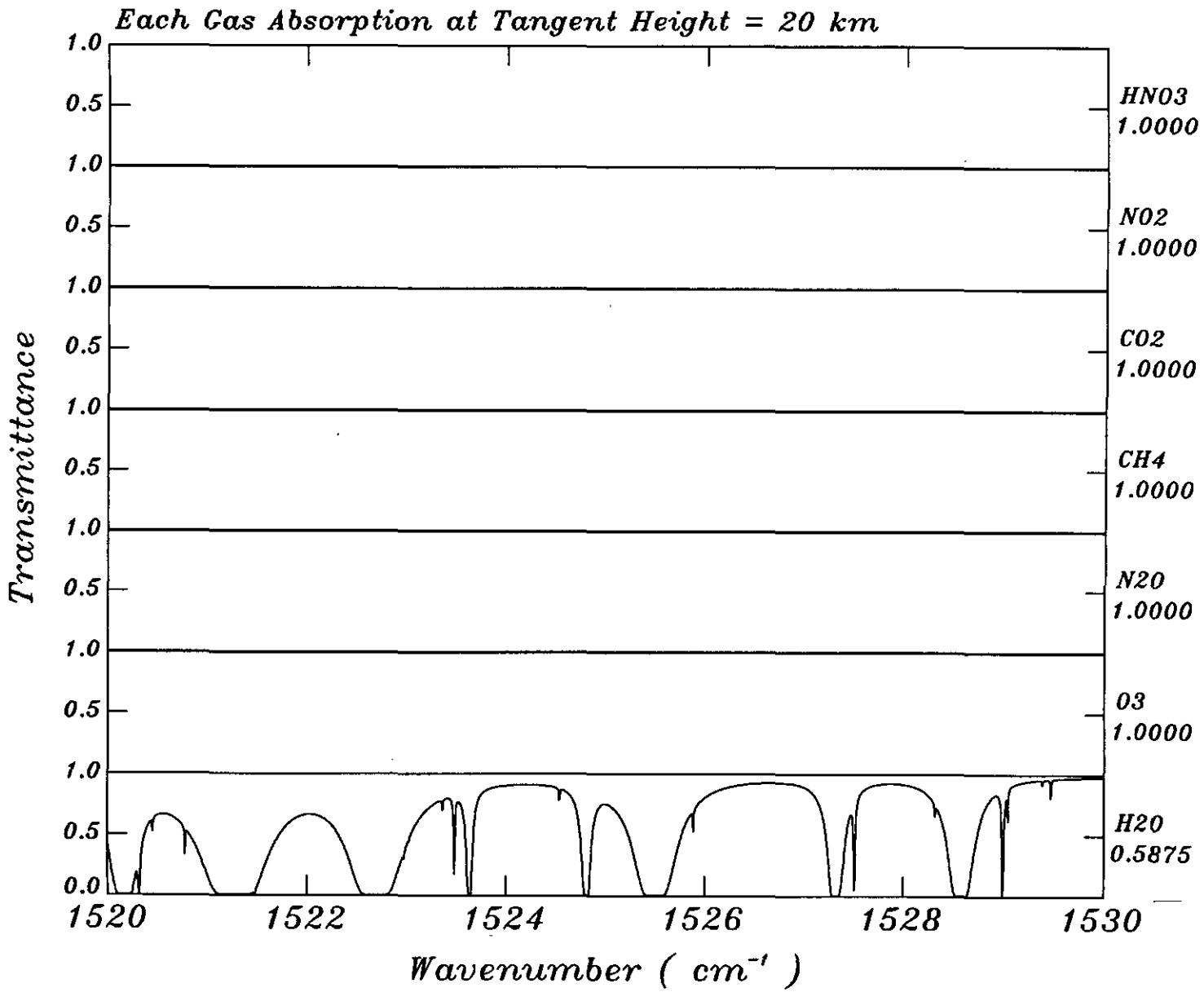

CH4
H2O
50.km
.99452
40.km
.98421
30.km
.93384
20.km
.72955
10.km
.00000
line#
54
Transmittance
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
1490
1492
1494
1496
1498
1500
Wavenumber (cm⁻¹)

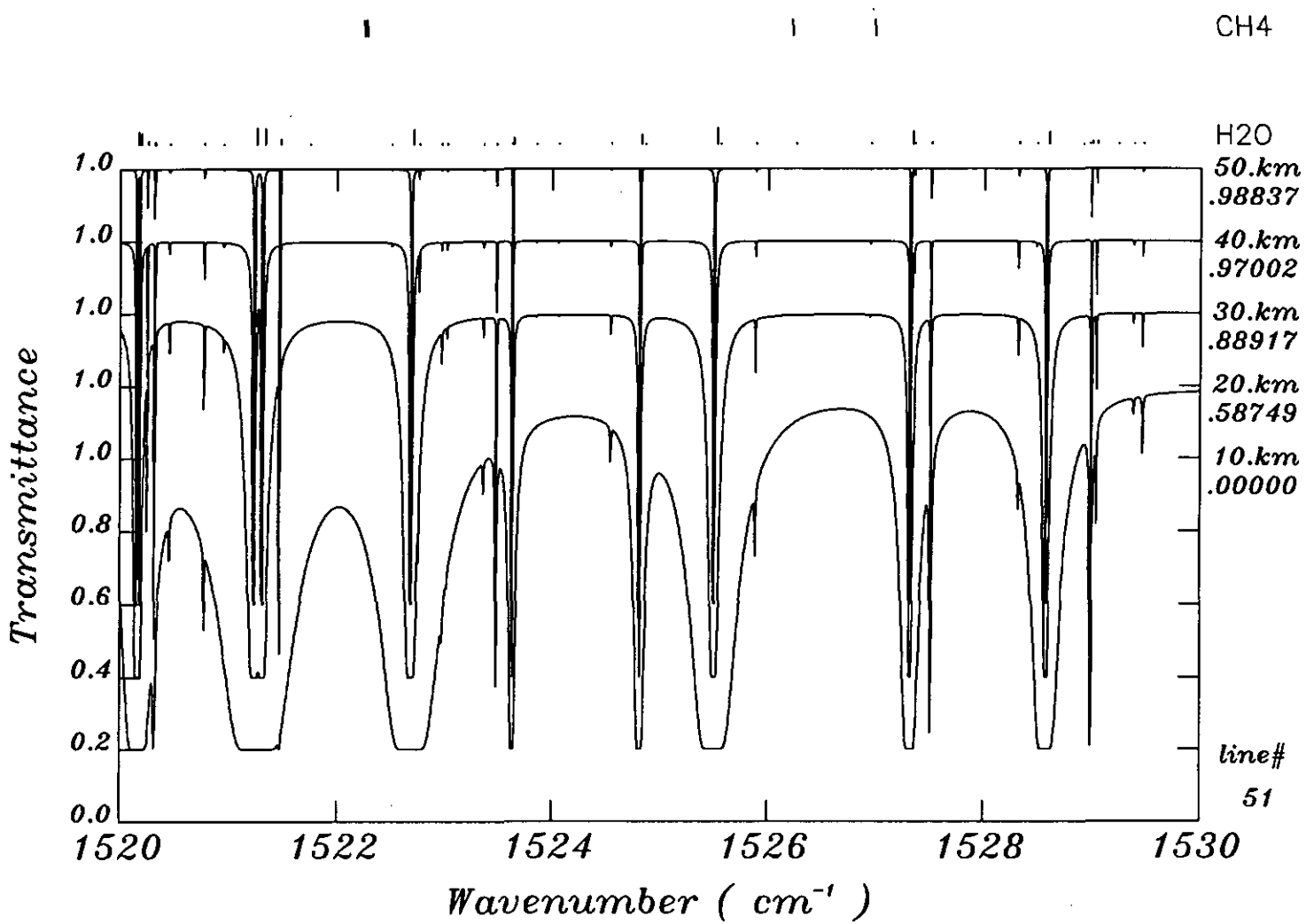

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
0.5
0.0
HNO3
1.0000
NO2
1.0000
CO2
1.0000
CH4
0.9958
N2O
1.0000
O3
1.0000
H2O
0.5799
1500
1502
1504
1506
1508
1510
Wavenumber (cm⁻¹)

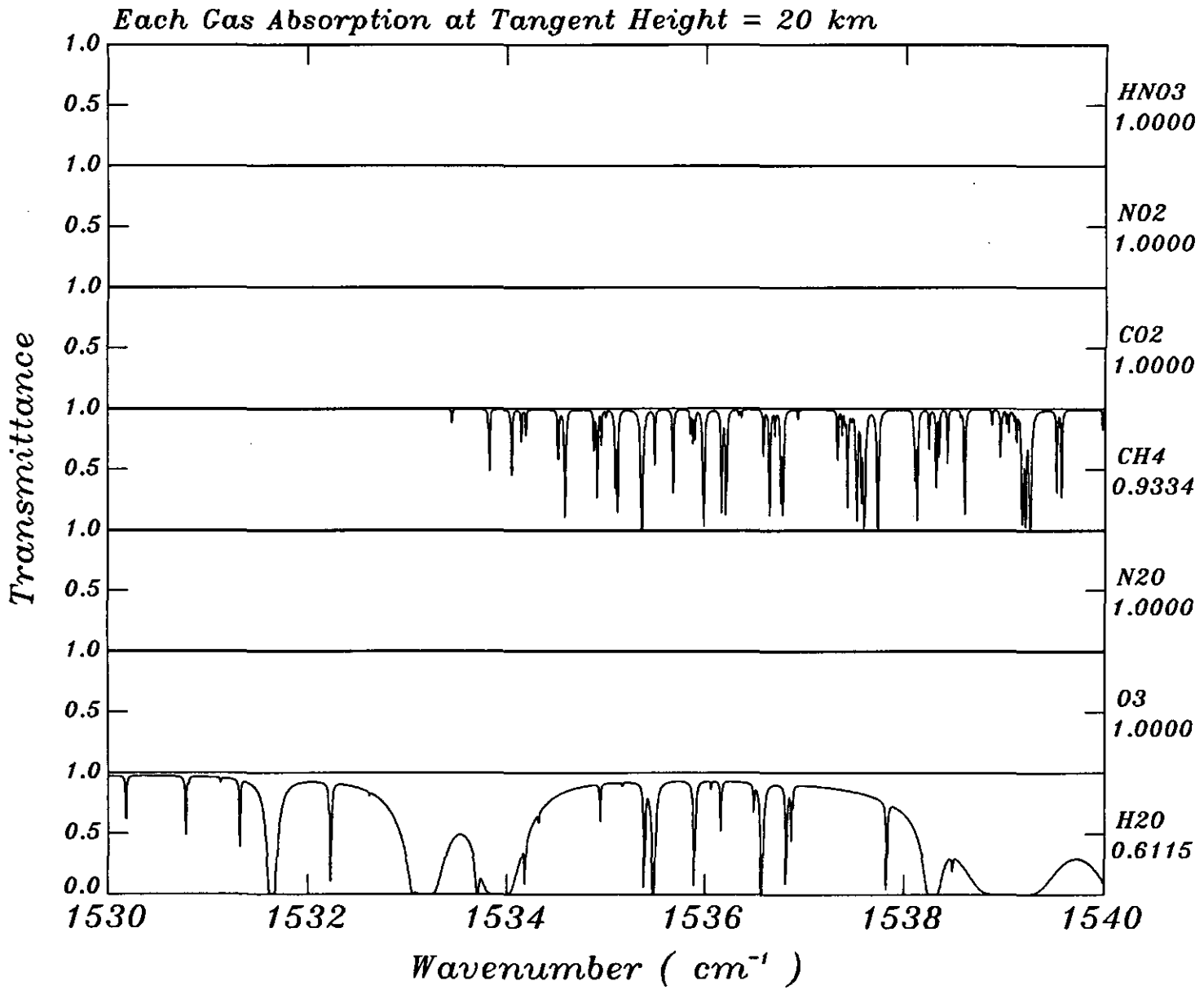

CH4
H2O
50.km
.98699
40.km
.96577
30.km
.87855
20.km
.57593
10.km
.00000
line#
103
Transmittance
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
1500
1502
1504
1506
1508
1510
Wavenumber (cm⁻¹)

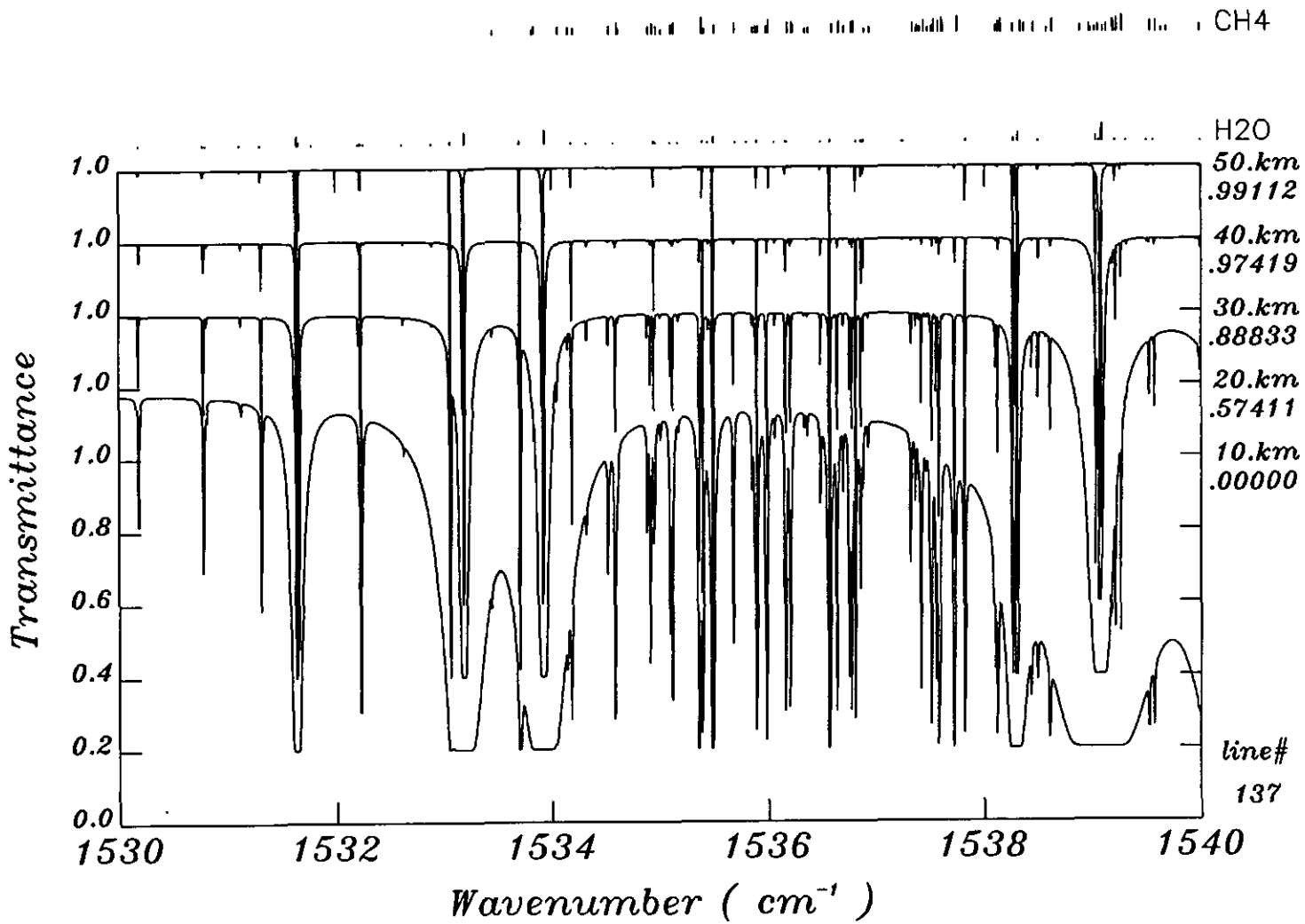

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
0.5
0.0
HNO3
1.0000
NO2
1.0000
CO2
1.0000
CH4
0.9995
N2O
1.0000
O3
1.0000
H2O
0.7262
1510
1512
1514
1516
1518
1520
Wavenumber (cm⁻¹)

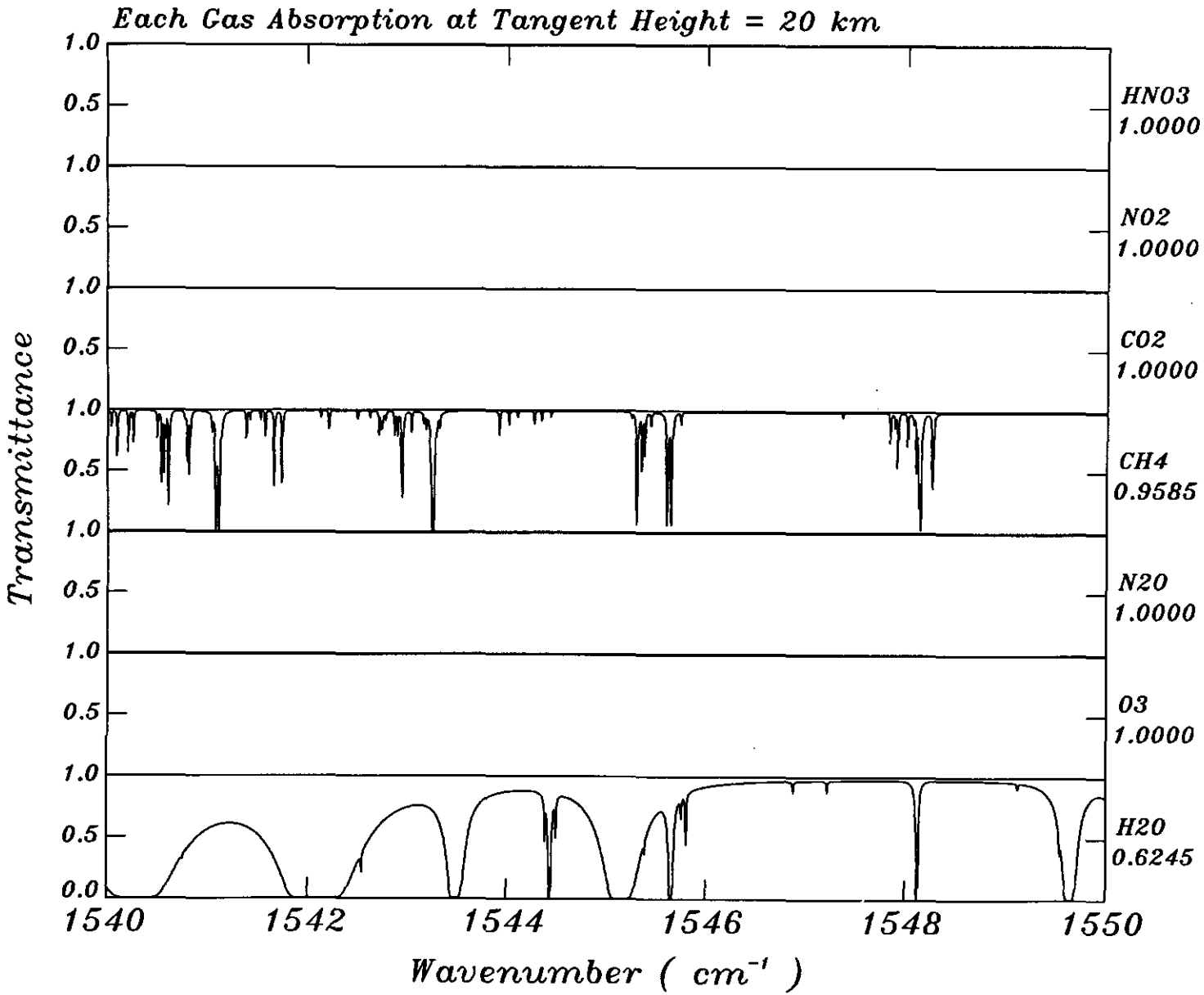

CH4
H2O
50.km
.99151
40.km
.98014
30.km
.93200
20.km
.72574
10.km
.00000
line#
92
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
Transmittance
1510
1512
1514
1516
1518
1520
Wavenumber (cm⁻¹)

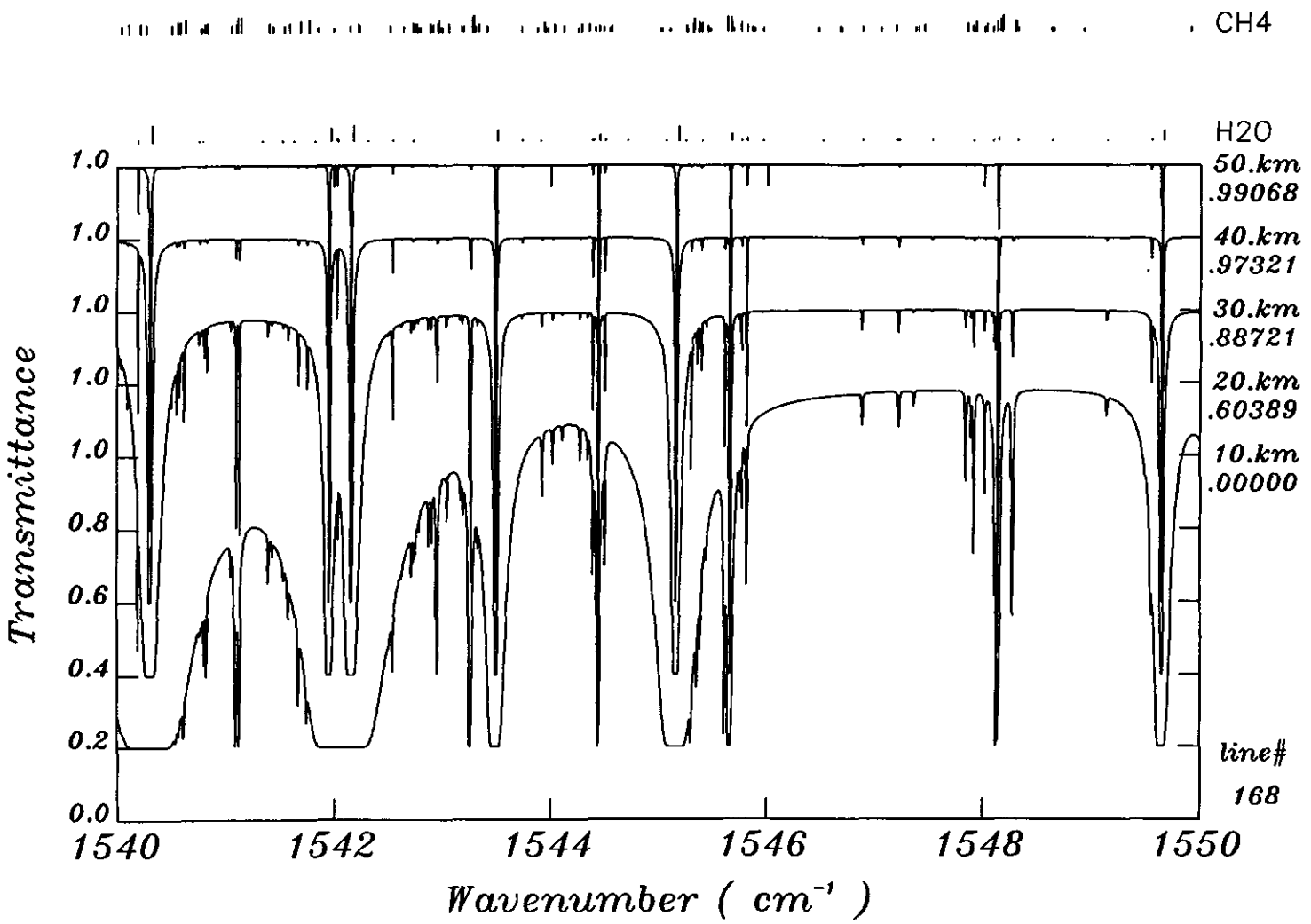

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
0.5
HN03
1.0000
NO2
1.0000
CO2
1.0000
CH4
1.0000
N20
1.0000
03
1.0000
H20
0.5875
0.0
1520
1522
1524
1526
1528
1530
Wavenumber (cm⁻¹)

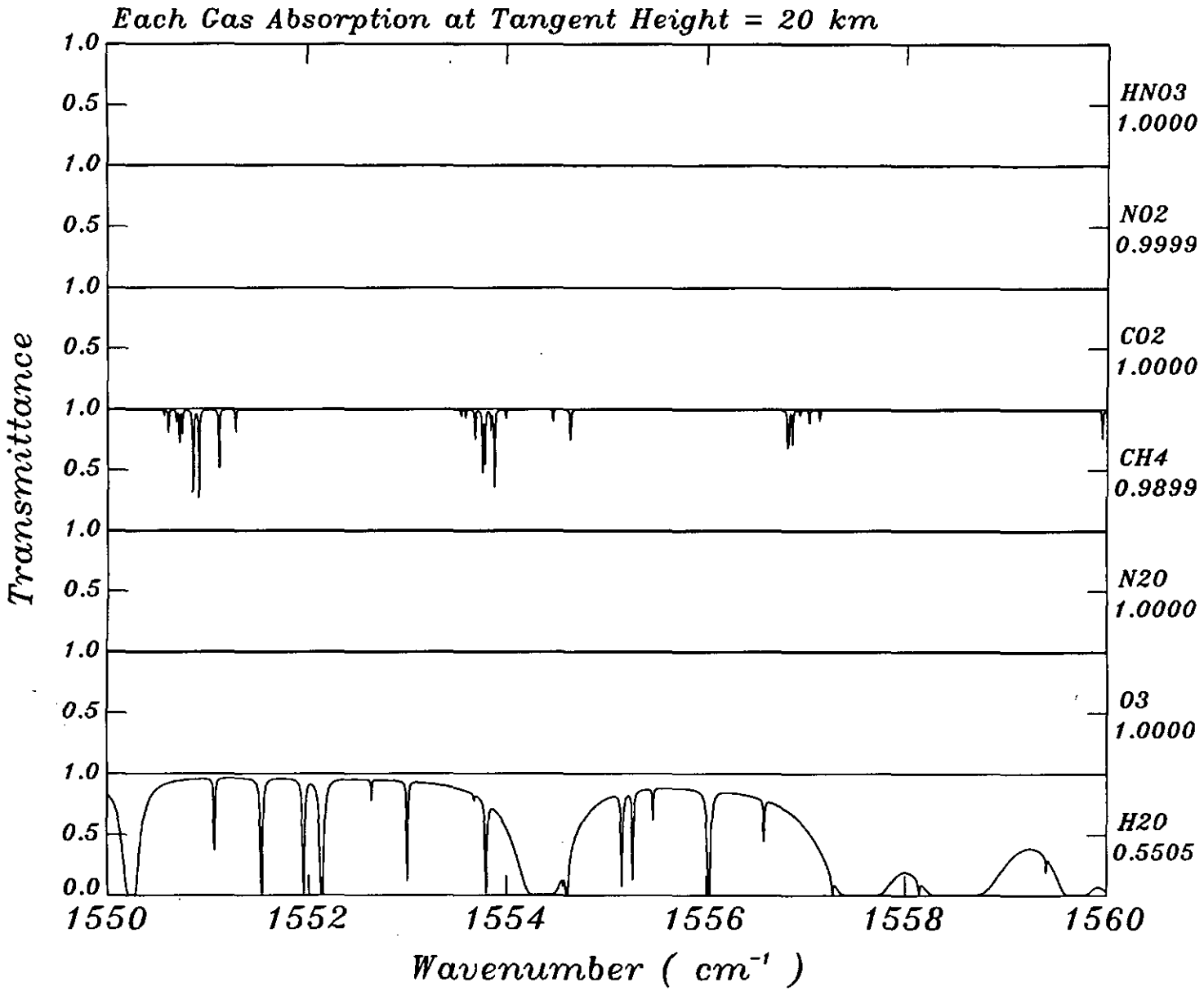

CH4
H2O
50.km
.98837
40.km
.97002
30.km
.88917
20.km
.58749
10.km
.00000
line#
51
Transmittance
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
1520
1522
1524
1526
1528
1530
Wavenumber (cm⁻¹)

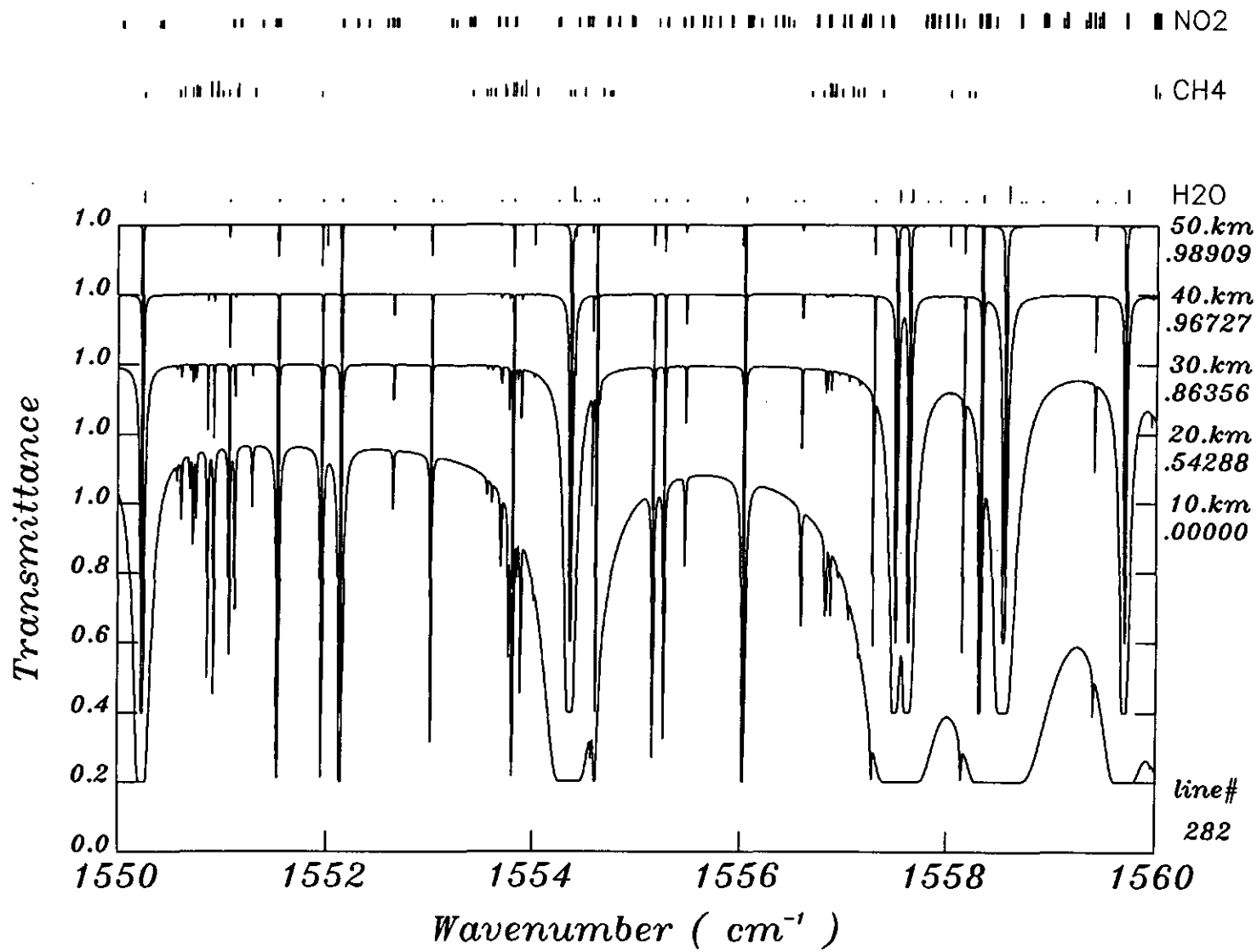

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
0.5
0.0
HNO3
1.0000
NO2
1.0000
CO2
1.0000
CH4
0.9334
N2O
1.0000
O3
1.0000
H2O
0.6115
1530
1532
1534
1536
1538
1540
Wavenumber (cm⁻¹)

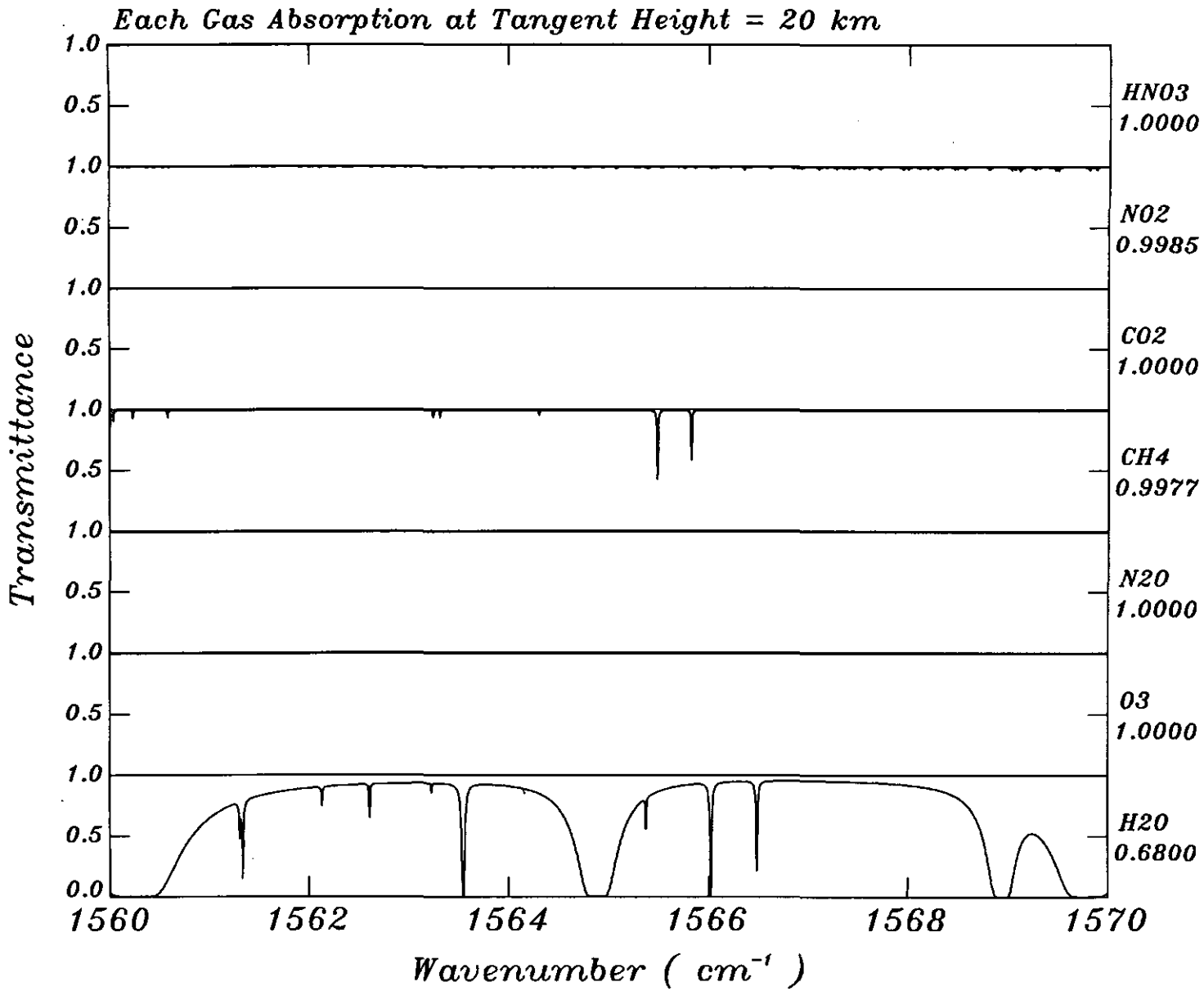

CH4
H2O
50.km
.99112
40.km
.97419
30.km
.88833
20.km
.57411
10.km
.00000
line#
137
Transmittance
1.0
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
1530
1532
1534
1536
1538
1540
Wavenumber (cm⁻¹)

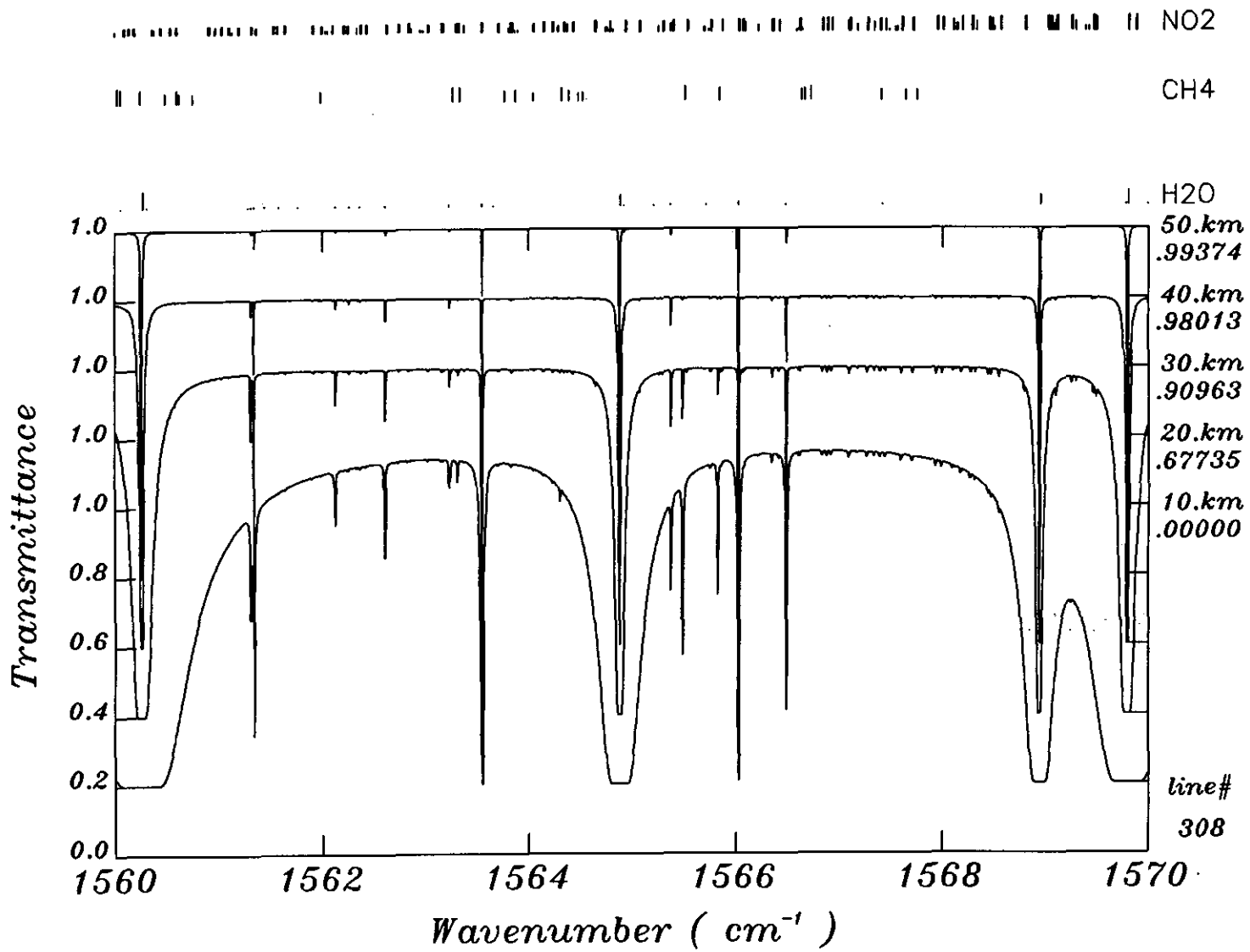

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
0.5
HN03
1.0000
NO2
1.0000
CO2
1.0000
CH4
0.9585
N20
1.0000
03
1.0000
H20
0.6245
0.0
1540
1542
1544
1546
1548
1550
Wavenumber (cm⁻¹)

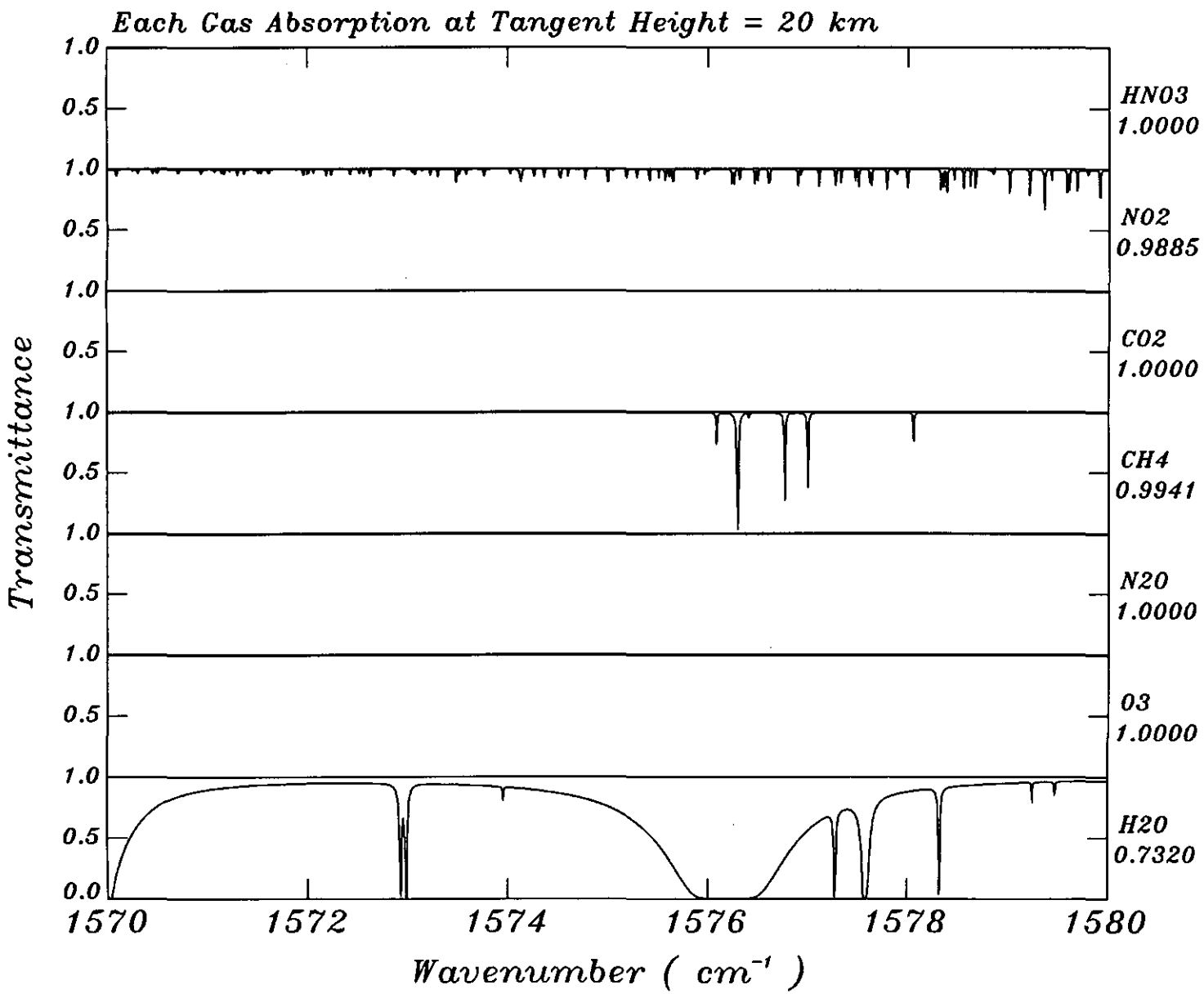

CH4
H2O
50.km
.99068
40.km
.97321
30.km
.88721
20.km
.60389
10.km
.00000
line#
168
Transmittance
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
1540
1542
1544
1546
1548
1550
Wavenumber (cm⁻¹)

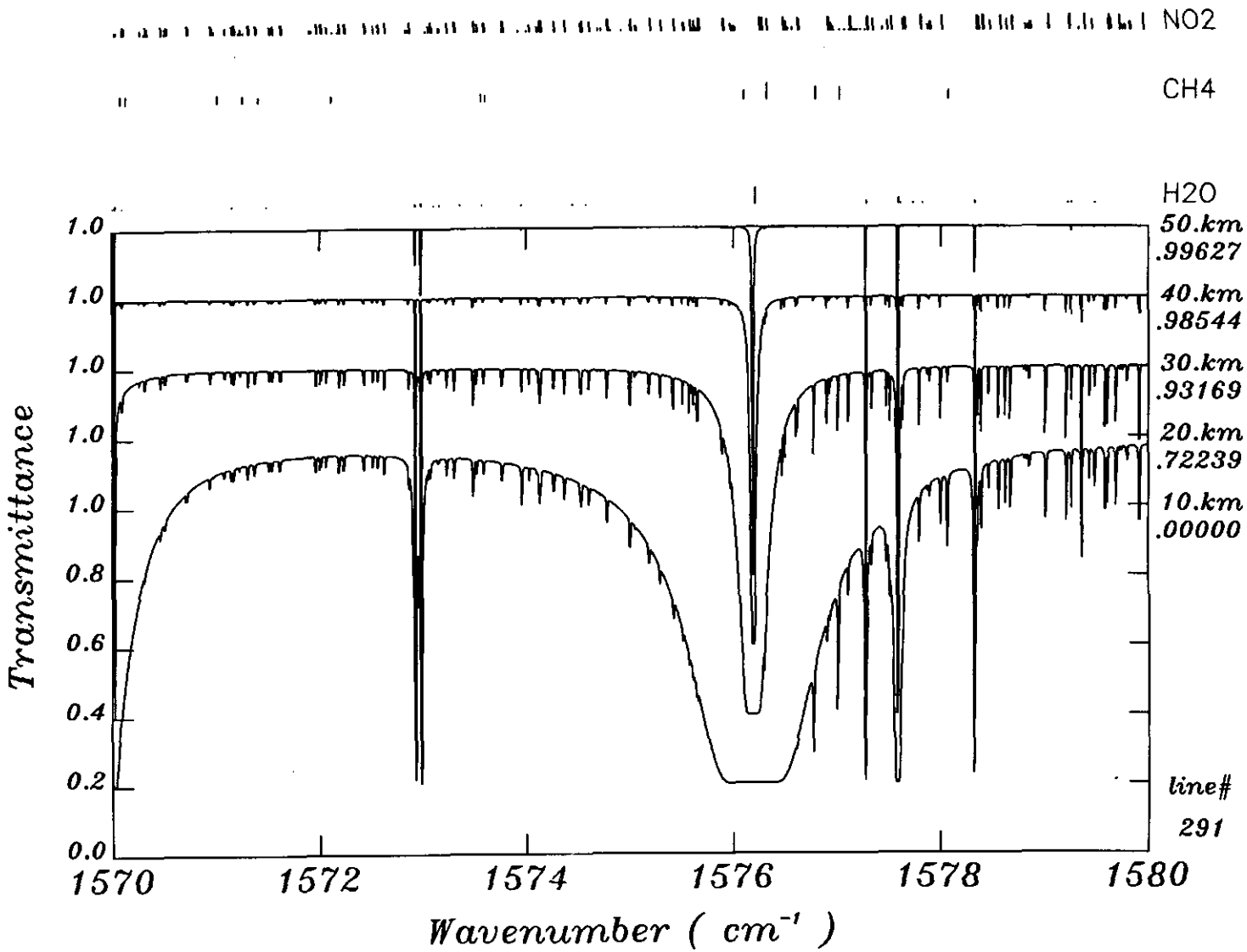

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
0.5
0.0
HNO3
1.0000
NO2
0.9999
CO2
1.0000
CH4
0.9899
N2O
1.0000
O3
1.0000
H2O
0.5505
1550
1552
1554
1556
1558
1560
Wavenumber (cm⁻¹)

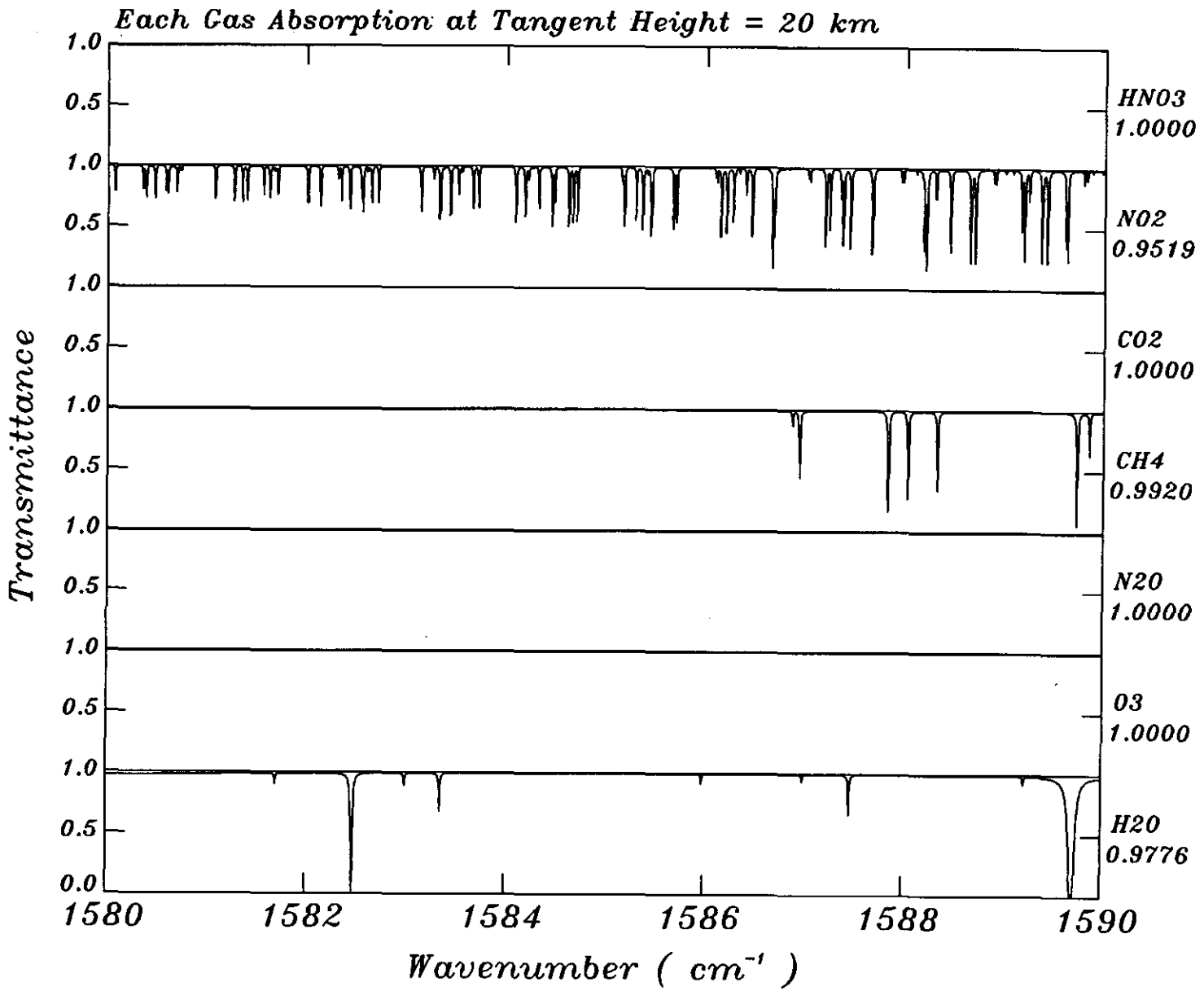

NO2
CH4
H2O
50.km
.98909
40.km
.96727
30.km
.86356
20.km
.54288
10.km
.00000
line#
282
Transmittance
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
1550
1552
1554
1556
1558
1560
Wavenumber (cm⁻¹)

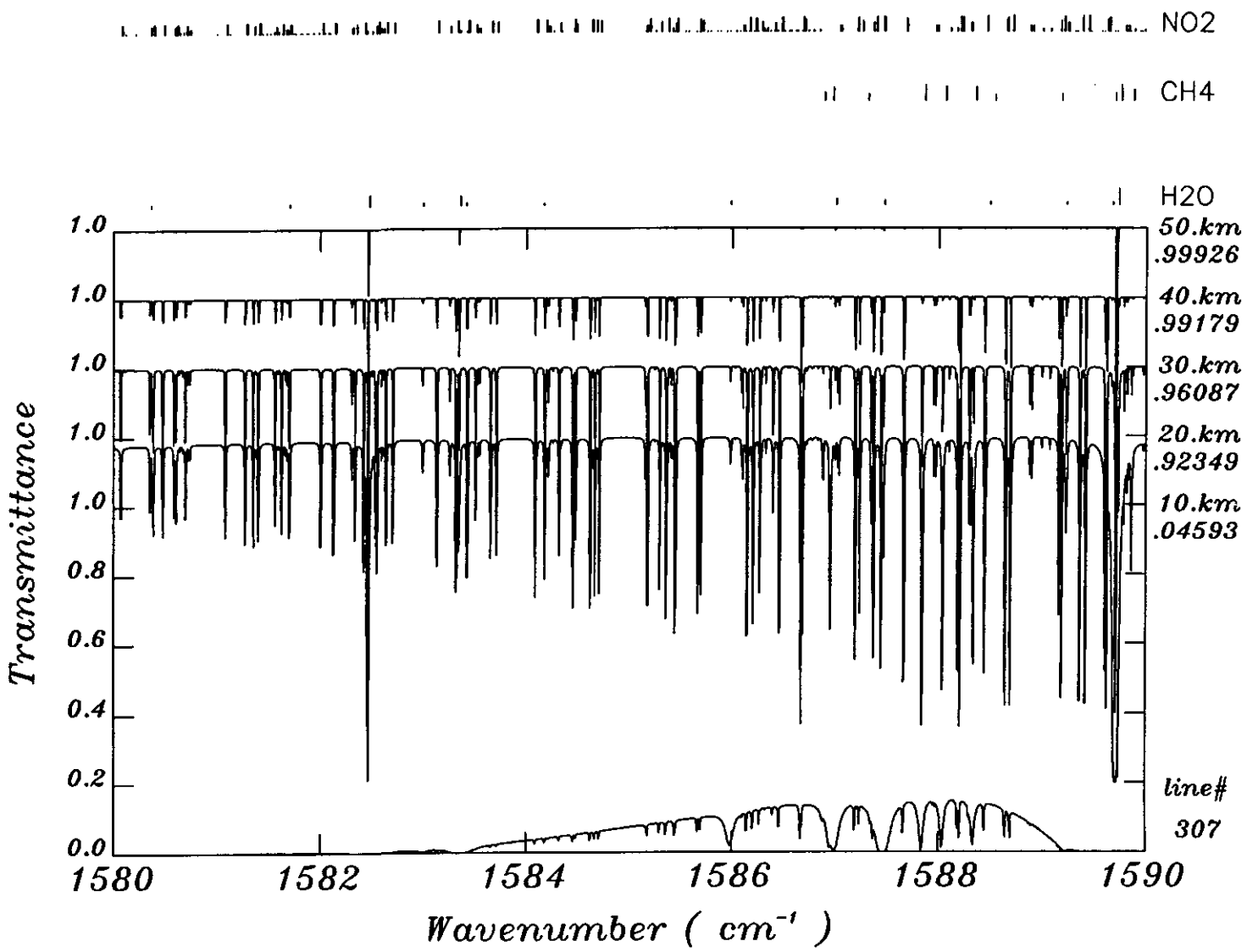

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
0.5
0.0
HN03
1.0000
NO2
0.9985
CO2
1.0000
CH4
0.9977
N2O
1.0000
O3
1.0000
H2O
0.6800
1560
1562
1564
1566
1568
1570
Wavenumber (cm⁻¹)

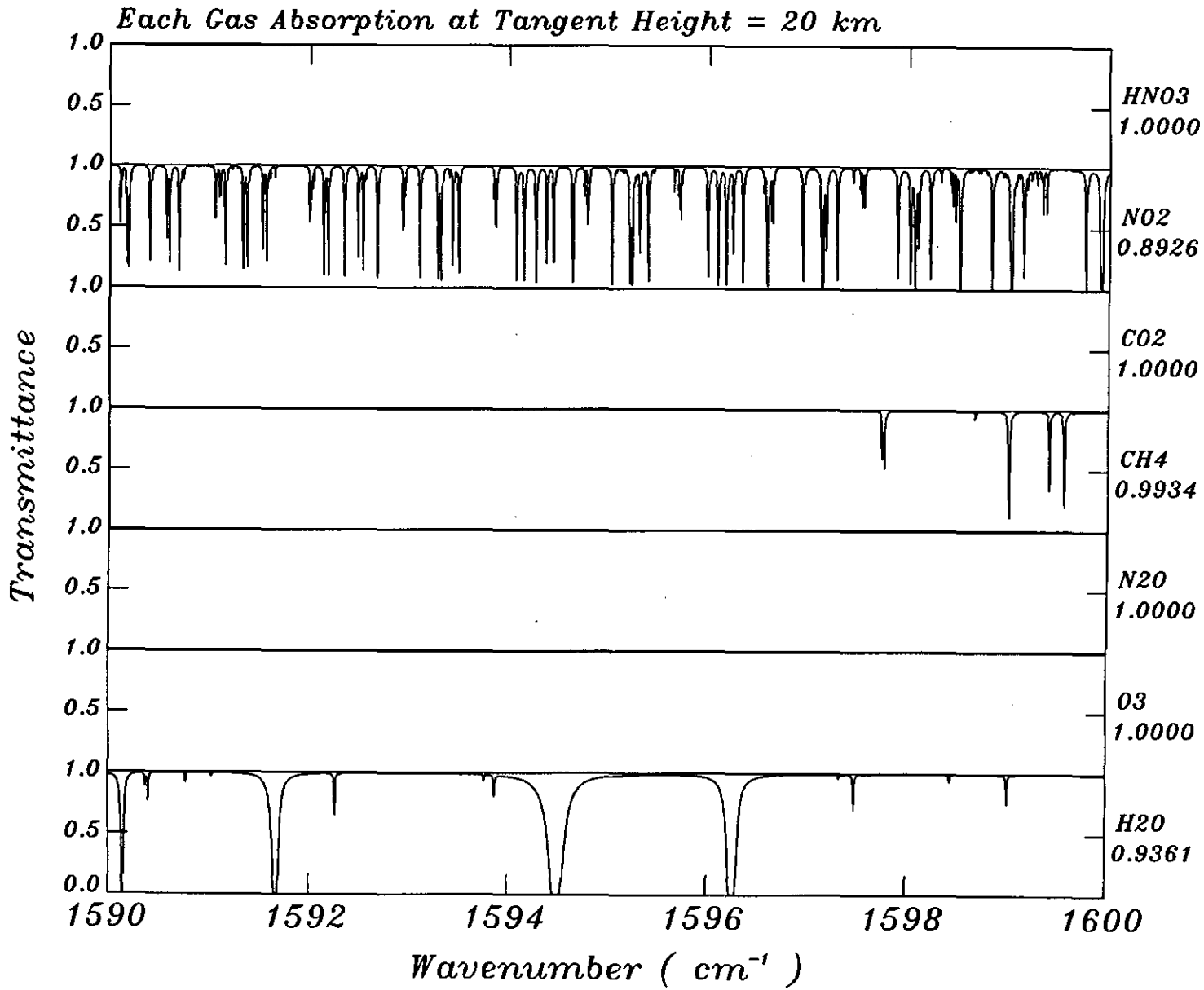

NO2
CH4
H2O
50.km
.99374
40.km
.98013
30.km
.90963
20.km
.67735
10.km
.00000
line#
308
Transmittance
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
1560
1562
1564
1566
1568
1570
Wavenumber (cm⁻¹)

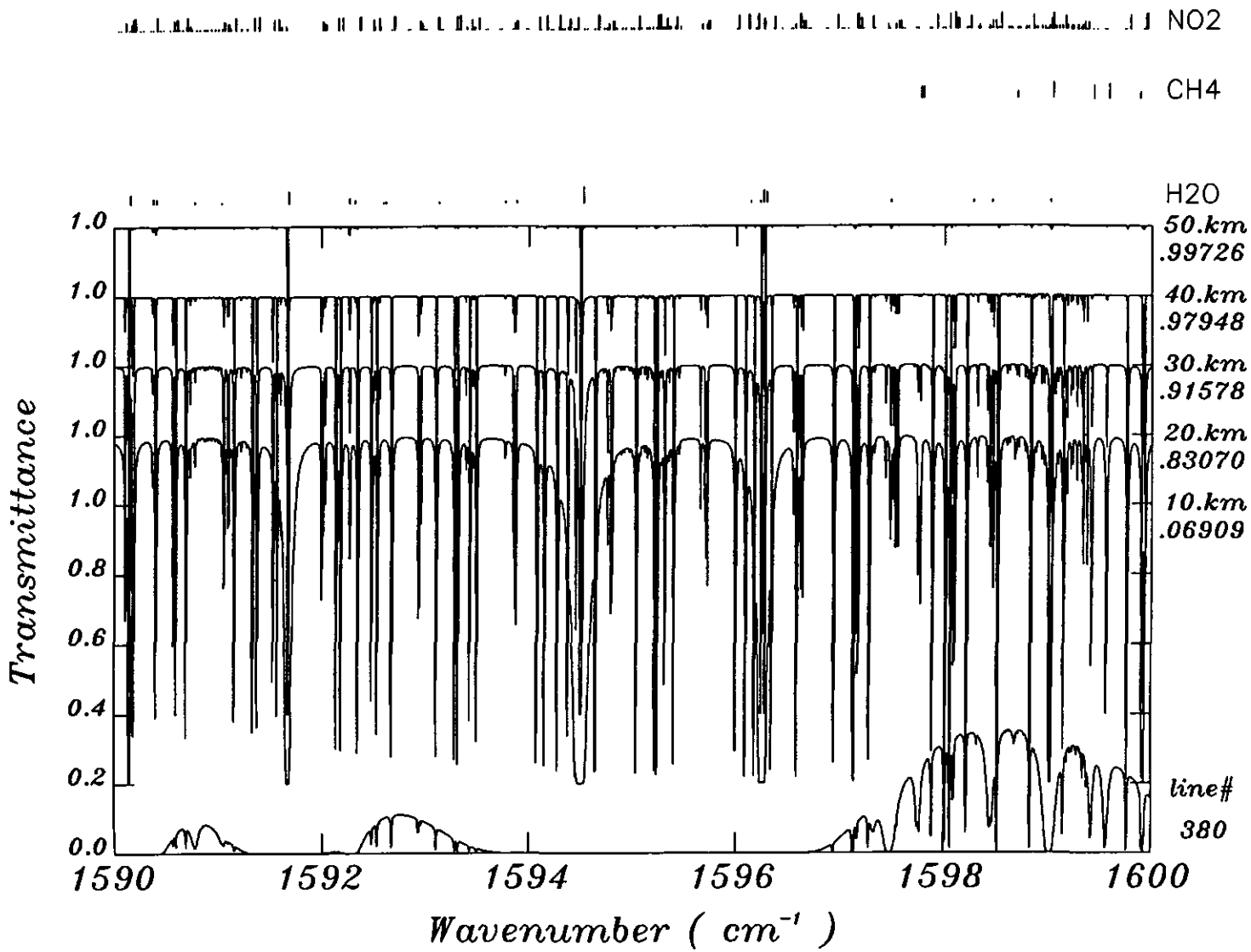

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
0.5
0.0
HN03
1.0000
NO2
0.9885
CO2
1.0000
CH4
0.9941
N20
1.0000
03
1.0000
H20
0.7320
1570
1572
1574
1576
1578
1580
Wavenumber (cm⁻¹)

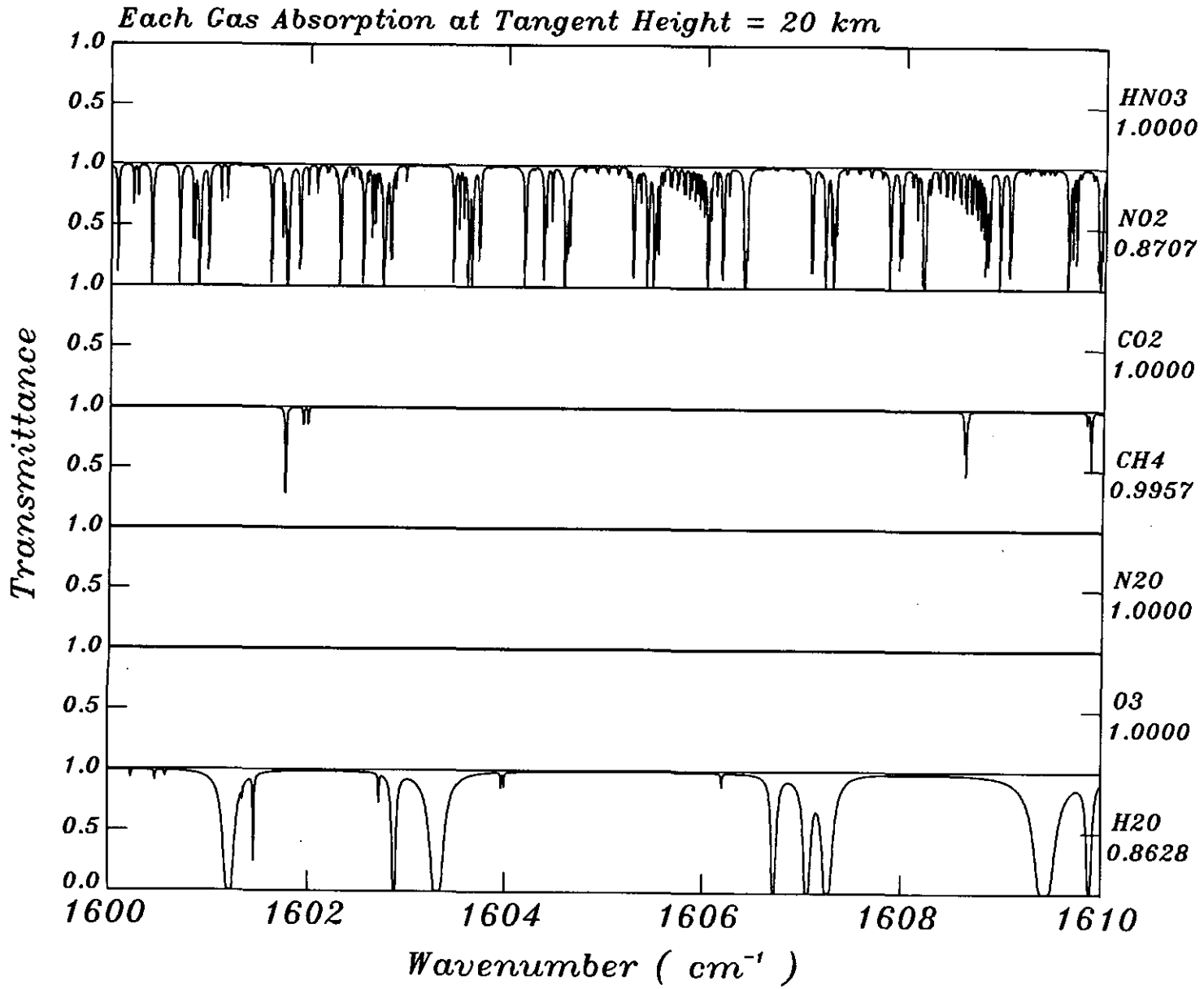

NO2
CH4
H2O
50.km
.99627
40.km
.98544
30.km
.93169
20.km
.72239
10.km
.00000
line#
291
Transmittance
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
1570
1572
1574
1576
1578
1580
Wavenumber (cm⁻¹)

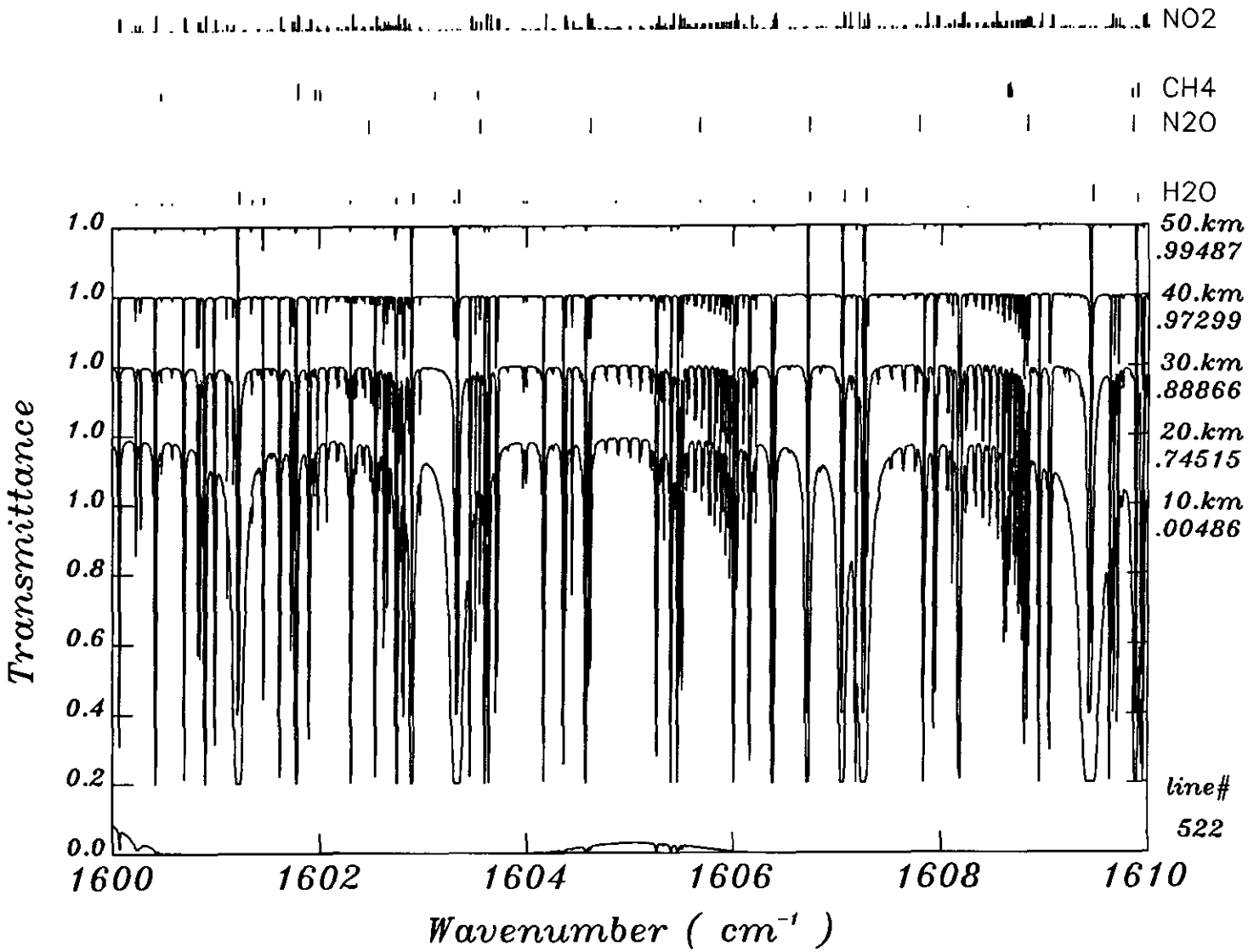

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
0.0
HN03
1.0000
N02
0.9519
C02
1.0000
CH4
0.9920
N20
1.0000
03
1.0000
H20
0.9776
1580
1582
1584
1586
1588
1590
Wavenumber (cm-1)

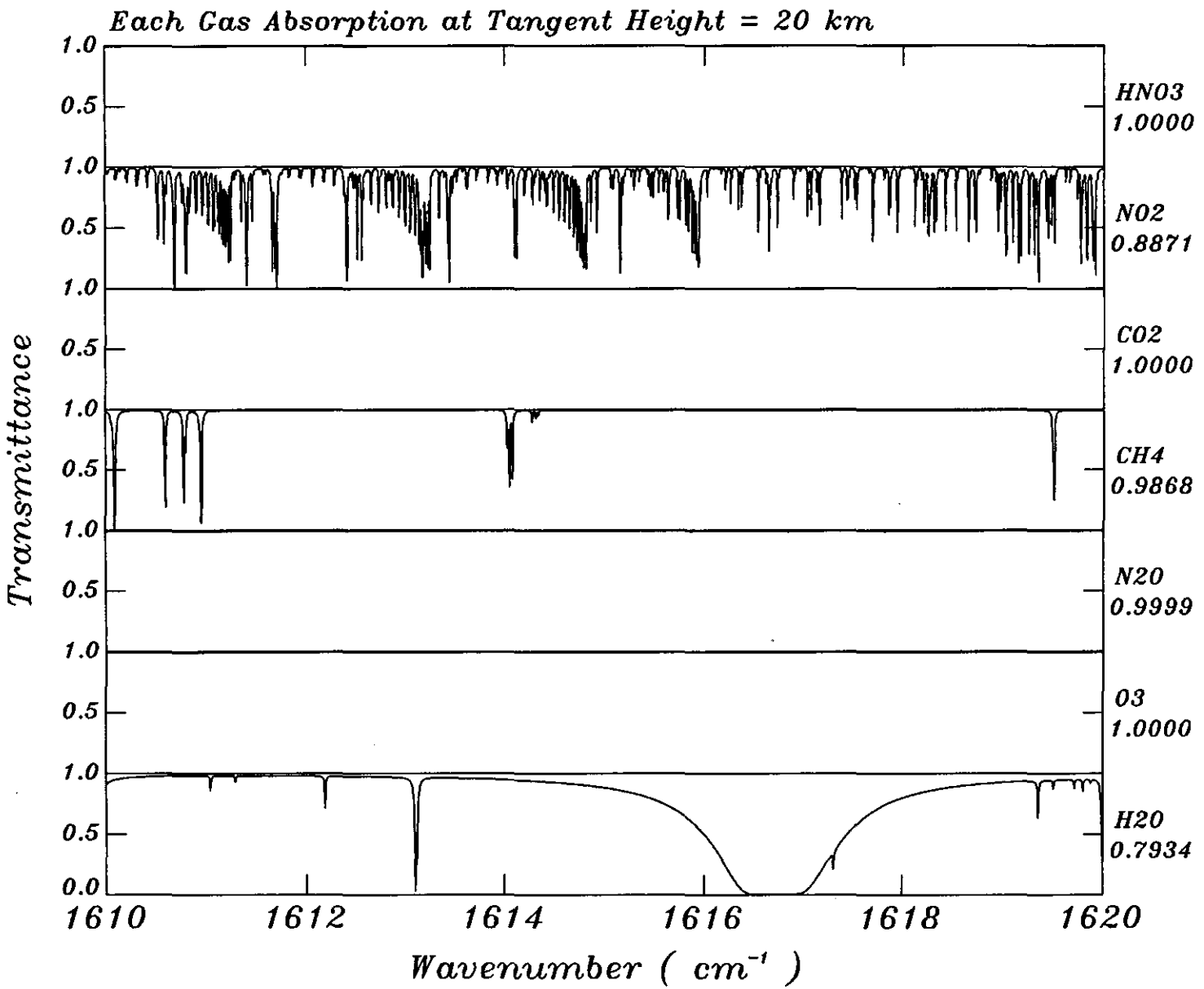

NO2
CH4
H2O
50.km
.99926
40.km
.99179
30.km
.96087
20.km
.92349
10.km
.04593
line#
307
Transmittance
1.0
0.8
0.6
0.4
0.2
0.0
1580
1582
1584
1586
1588
1590
Wavenumber (cm⁻¹)

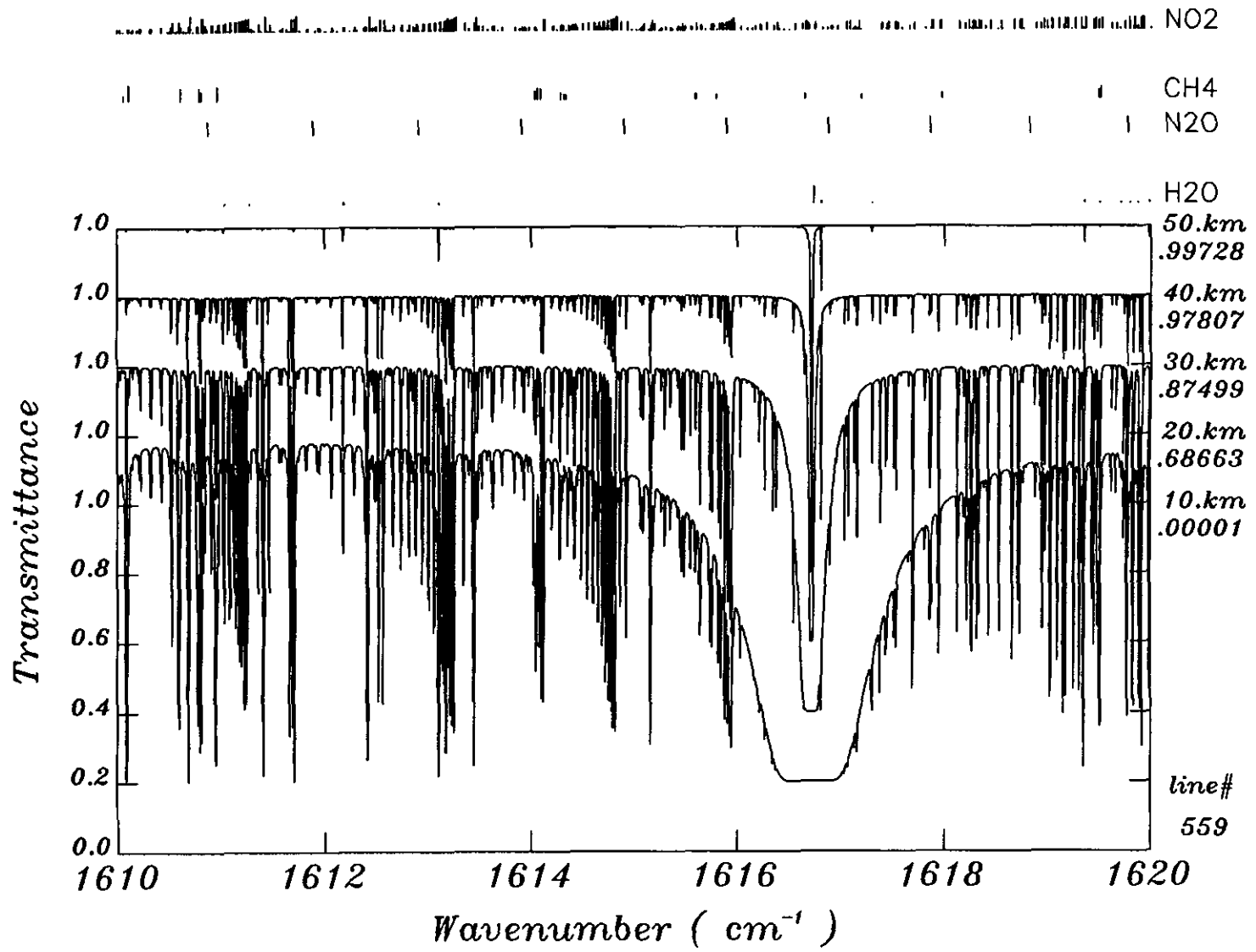

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
0.5
0.0
HNO3
1.0000
NO2
0.8926
CO2
1.0000
CH4
0.9934
N2O
1.0000
O3
1.0000
H2O
0.9361
1590
1592
1594
1596
1598
1600
Wavenumber (cm⁻¹)

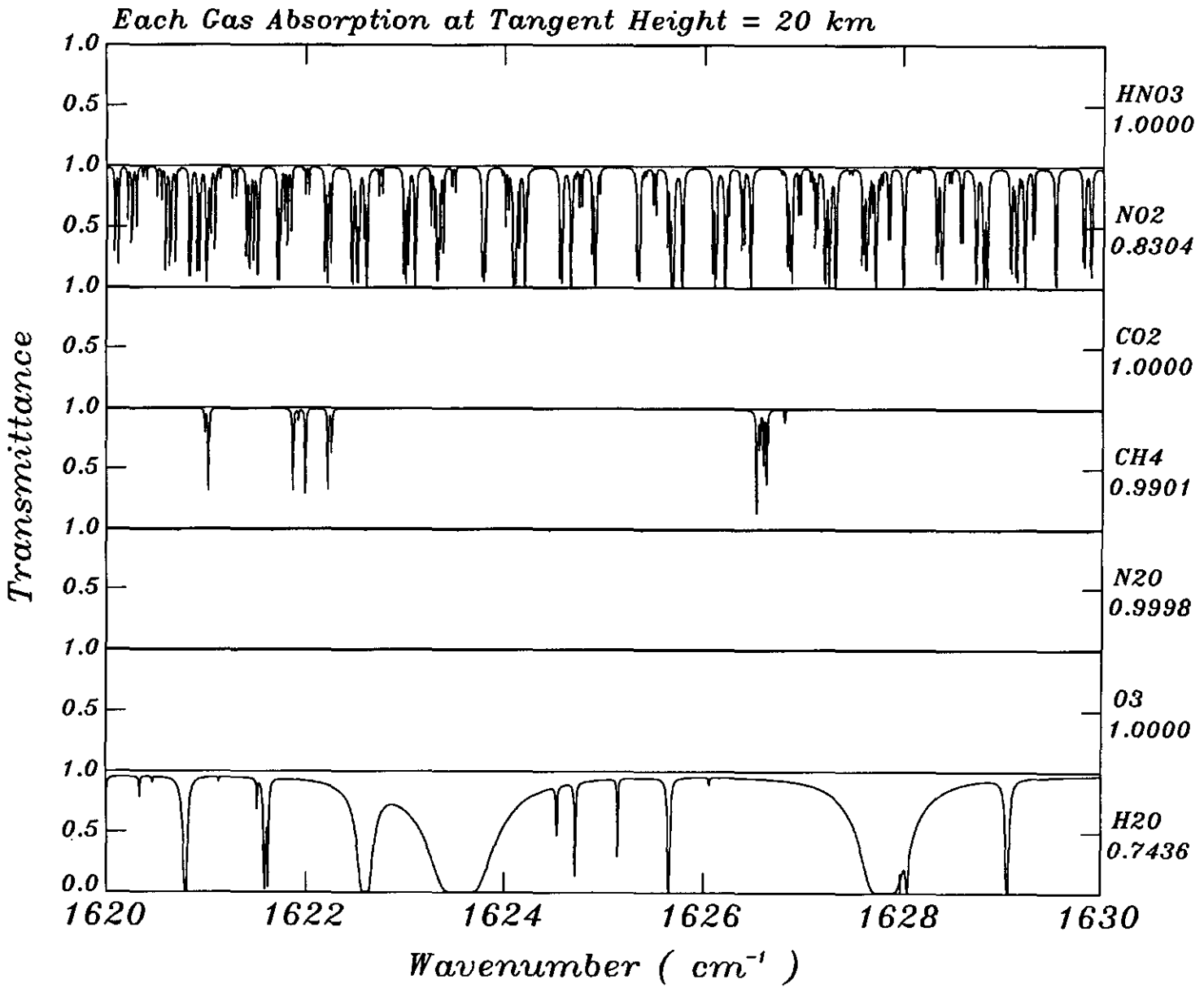

NO2
CH4
H2O
50.km
.99726
40.km
.97948
30.km
.91578
20.km
.83070
10.km
.06909
line#
380
Transmittance
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
1590
1592
1594
1596
1598
1600
Wavenumber (cm⁻¹)

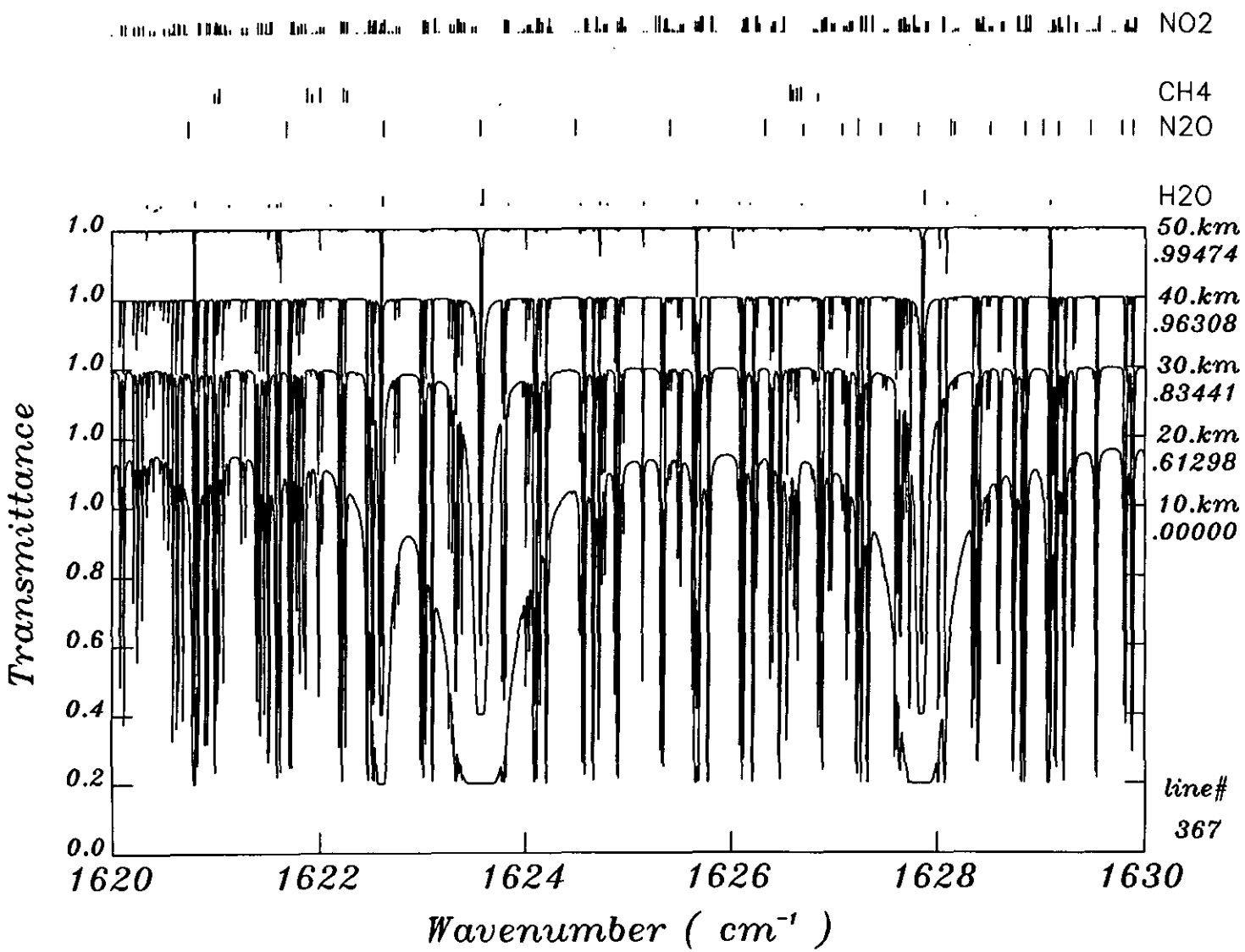

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
0.5
0.0
HNO3
1.0000
NO2
0.8707
CO2
1.0000
CH4
0.9957
N2O
1.0000
O3
1.0000
H2O
0.8628
1600
1602
1604
1606
1608
1610
Wavenumber (cm⁻¹)

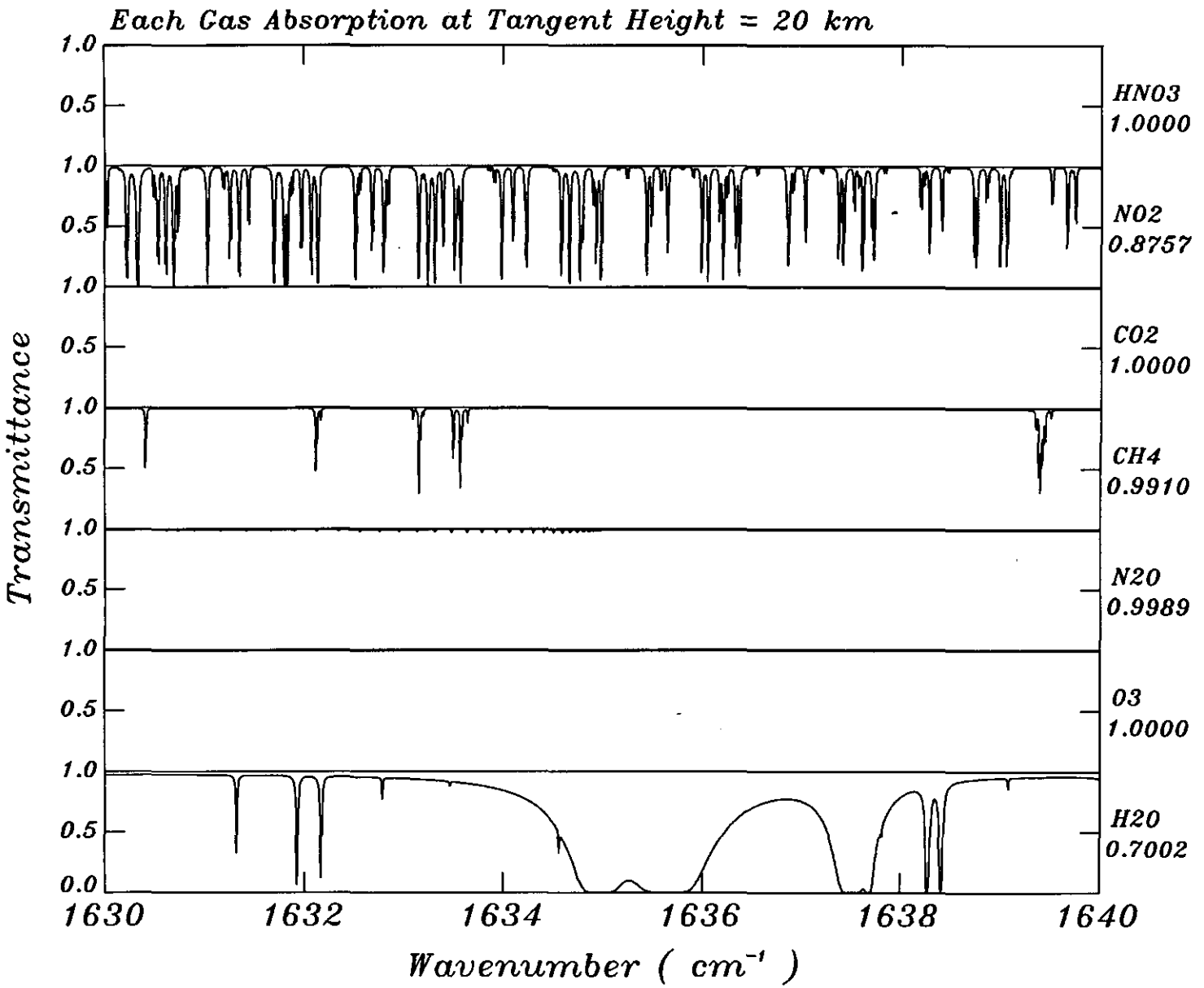

NO2
CH4
N2O
H2O
50.km
.99487
40.km
.97299
30.km
.88866
20.km
.74515
10.km
.00486
line#
522
Transmittance
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
1600
1602
1604
1606
1608
1610
Wavenumber (cm⁻¹)

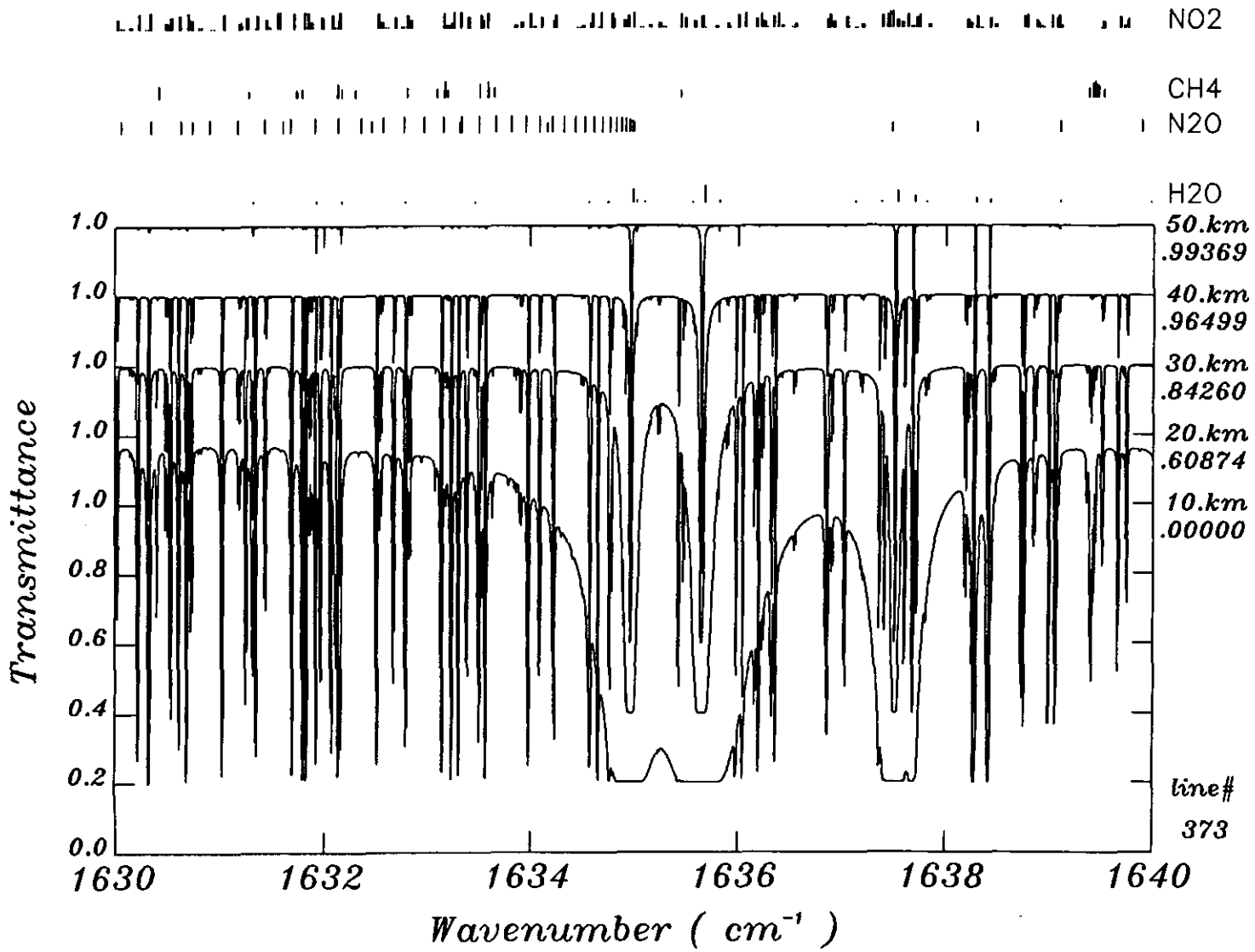

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
0.5
0.0
HN03
1.0000
NO2
0.8871
CO2
1.0000
CH4
0.9868
N20
0.9999
03
1.0000
H20
0.7934
1610
1612
1614
1616
1618
1620
Wavenumber (cm⁻¹)

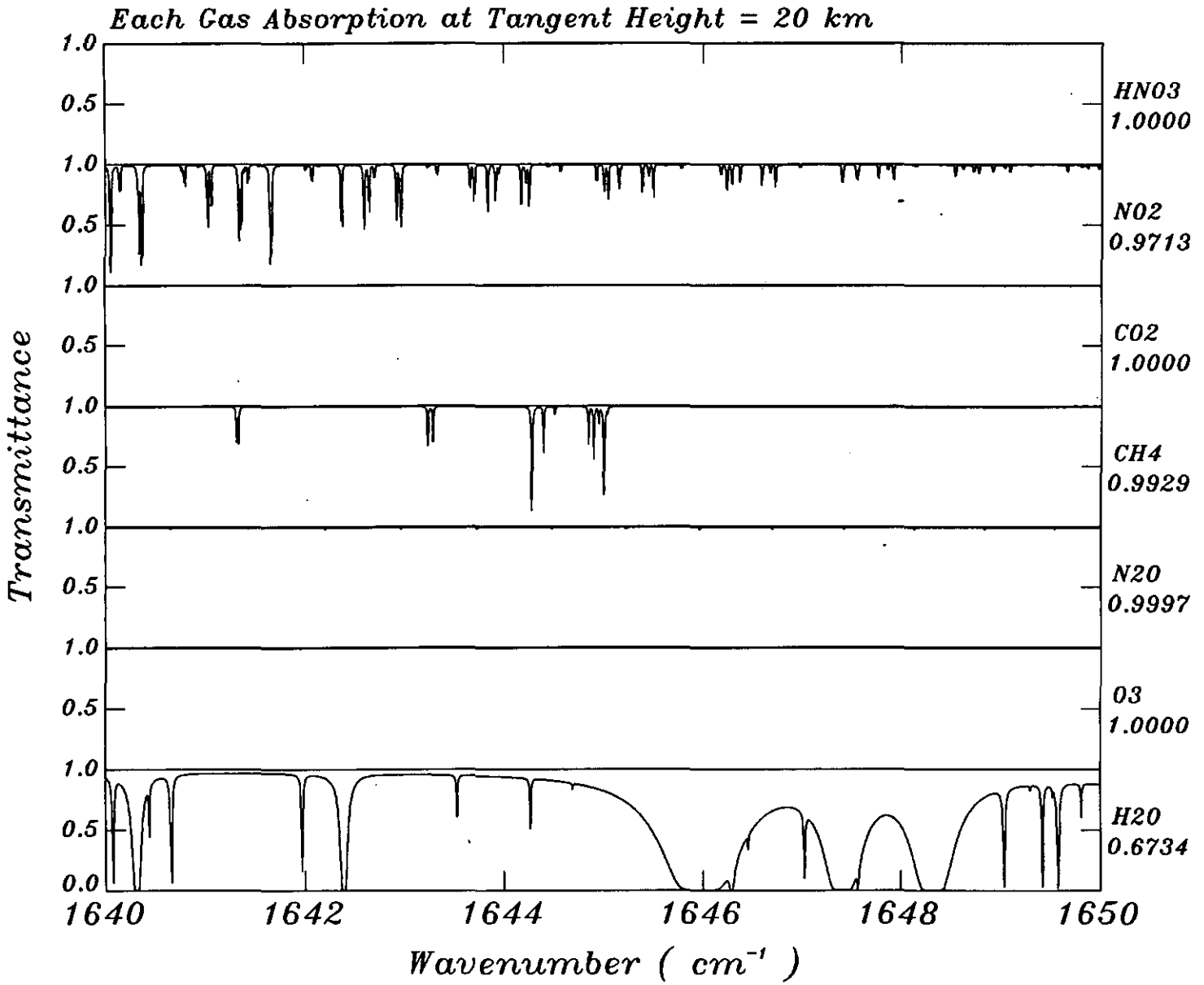

NO2
CH4
N2O
H2O
50.km
.99728
40.km
.97807
30.km
.87499
20.km
.68663
10.km
.00001
line#
559
Transmittance
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
1610
1612
1614
1616
1618
1620
Wavenumber (cm⁻¹)

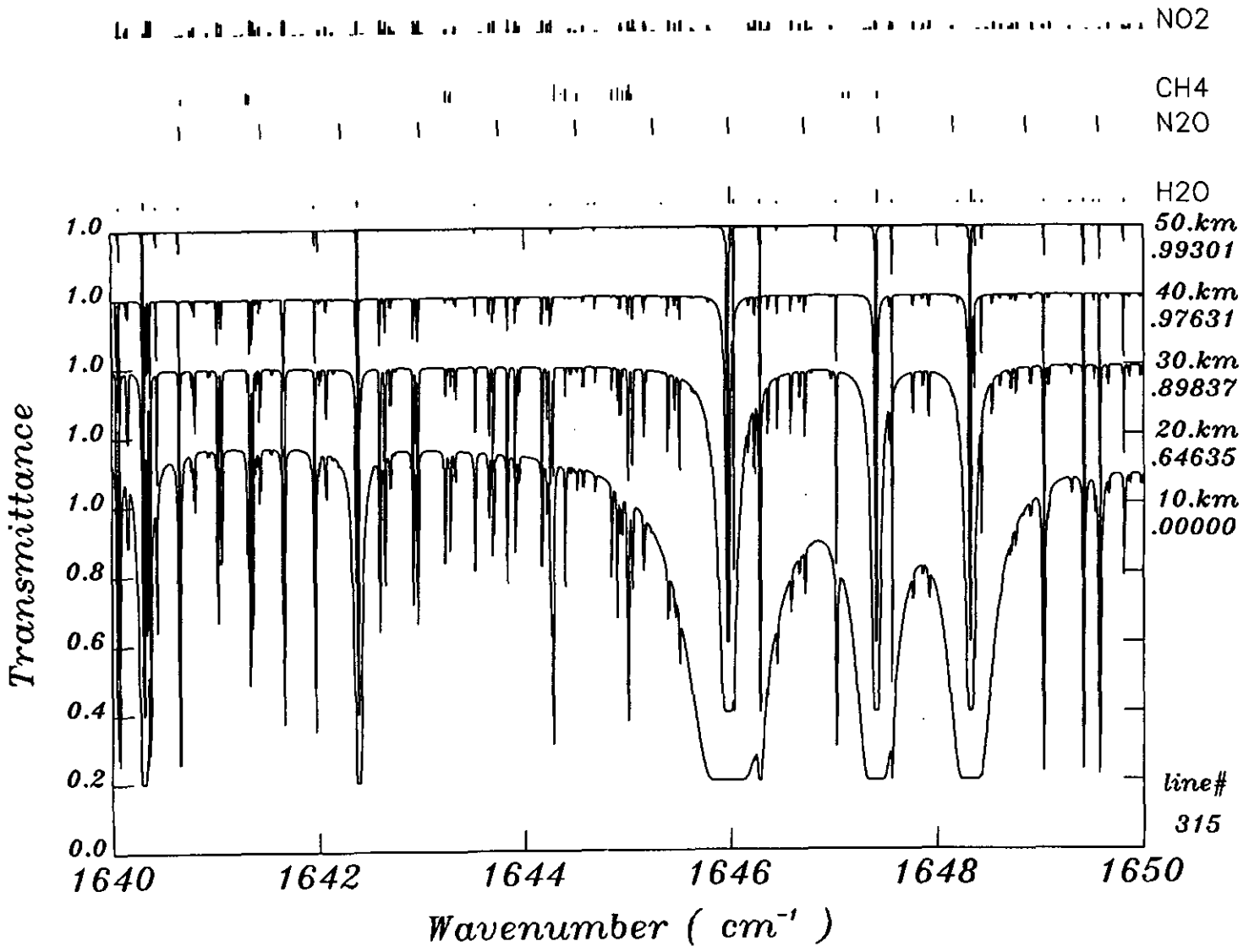

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
1.0
0.5
0.0
HN03
1.0000
N02
0.8304
C02
1.0000
CH4
0.9901
N20
0.9998
03
1.0000
H20
0.7436
1620
1622
1624
1626
1628
1630
Wavenumber (cm⁻¹)


NO2
CH4
N2O
H2O
50.km
.99474
40.km
.96308
30.km
.83441
20.km
.61298
10.km
.00000
line#
367
Transmittance
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
1620
1622
1624
1626
1628
1630
Wavenumber (cm⁻¹)


Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
0.5
0.0
HN03
1.0000
NO2
0.8757
CO2
1.0000
CH4
0.9910
N20
0.9989
03
1.0000
H20
0.7002
1630
1632
1634
1636
1638
1640
Wavenumber (cm⁻¹)

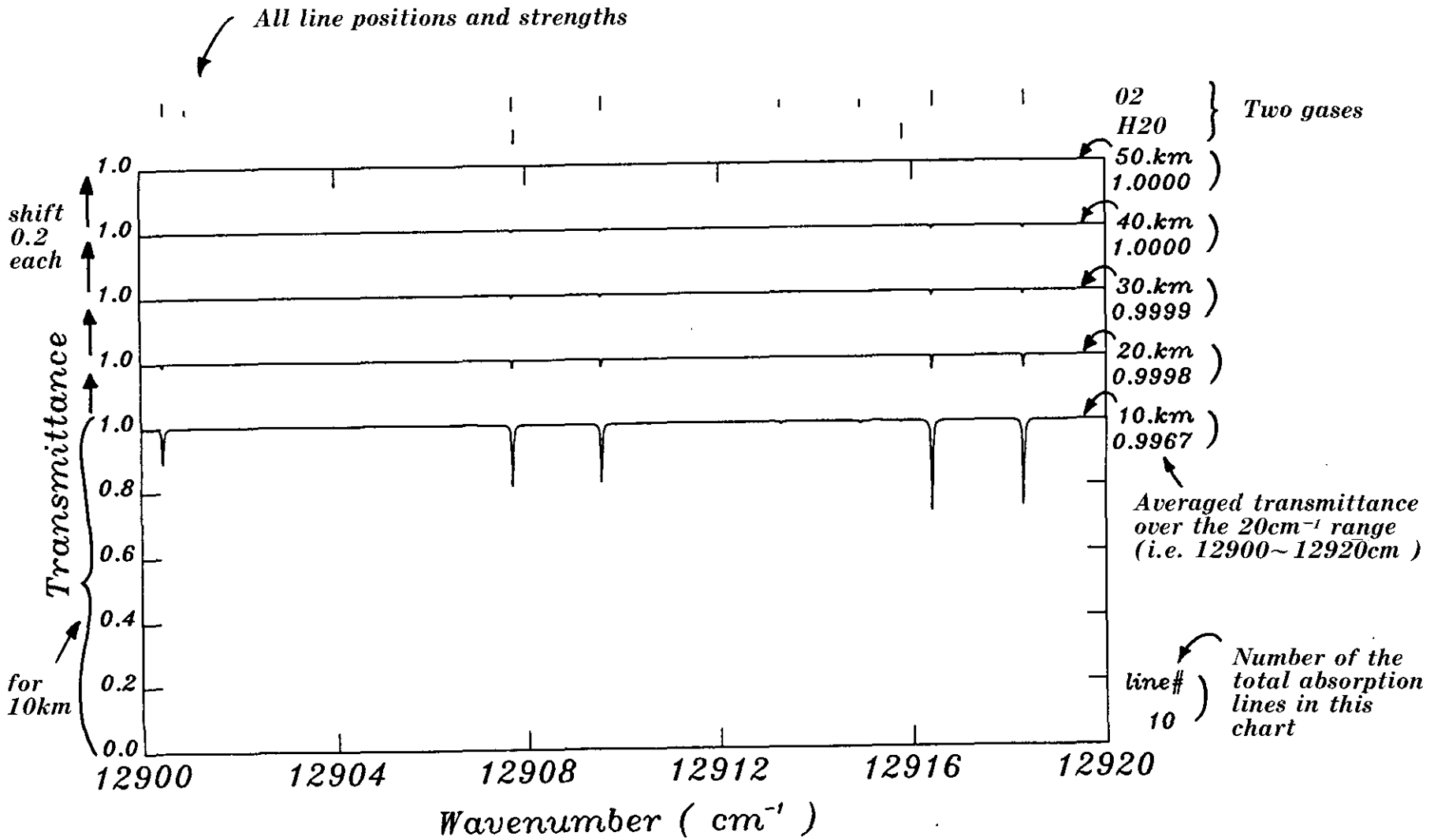

NO2
CH4
N2O
H2O
50.km
.99369
40.km
.96499
30.km
.84260
20.km
.60874
10.km
.00000
line#
373
Transmittance
1.0
0.8
0.6
0.4
0.2
0.0
1630
1632
1634
1636
1638
1640
Wavenumber (cm⁻¹)

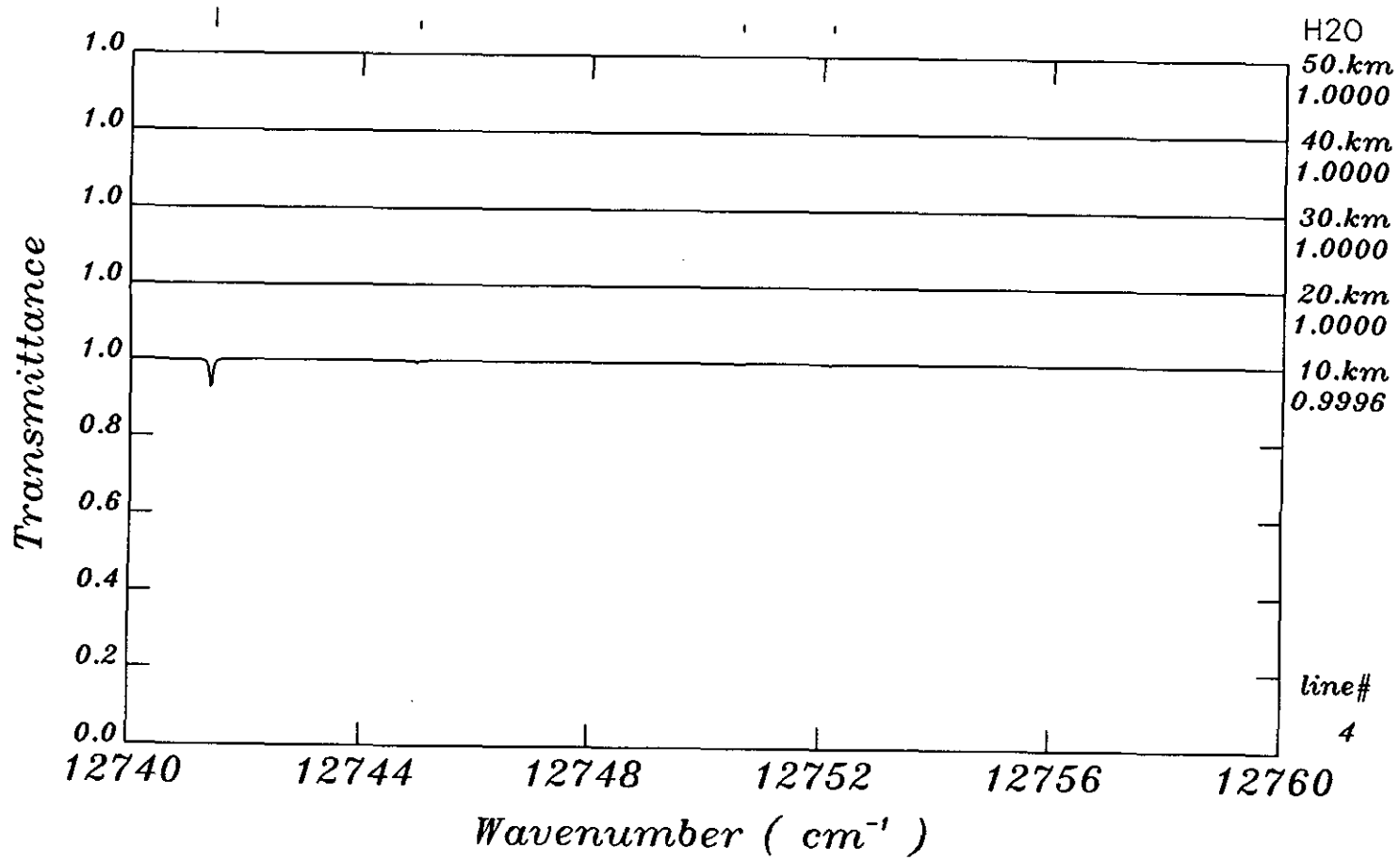

Each Gas Absorption at Tangent Height = 20 km
Transmittance
1.0
0.5
0.0
HN03
1.0000
N02
0.9713
C02
1.0000
CH4
0.9929
N20
0.9997
03
1.0000
H20
0.6734
1640
1642
1644
1646
1648
1650
Wavenumber (cm⁻¹)

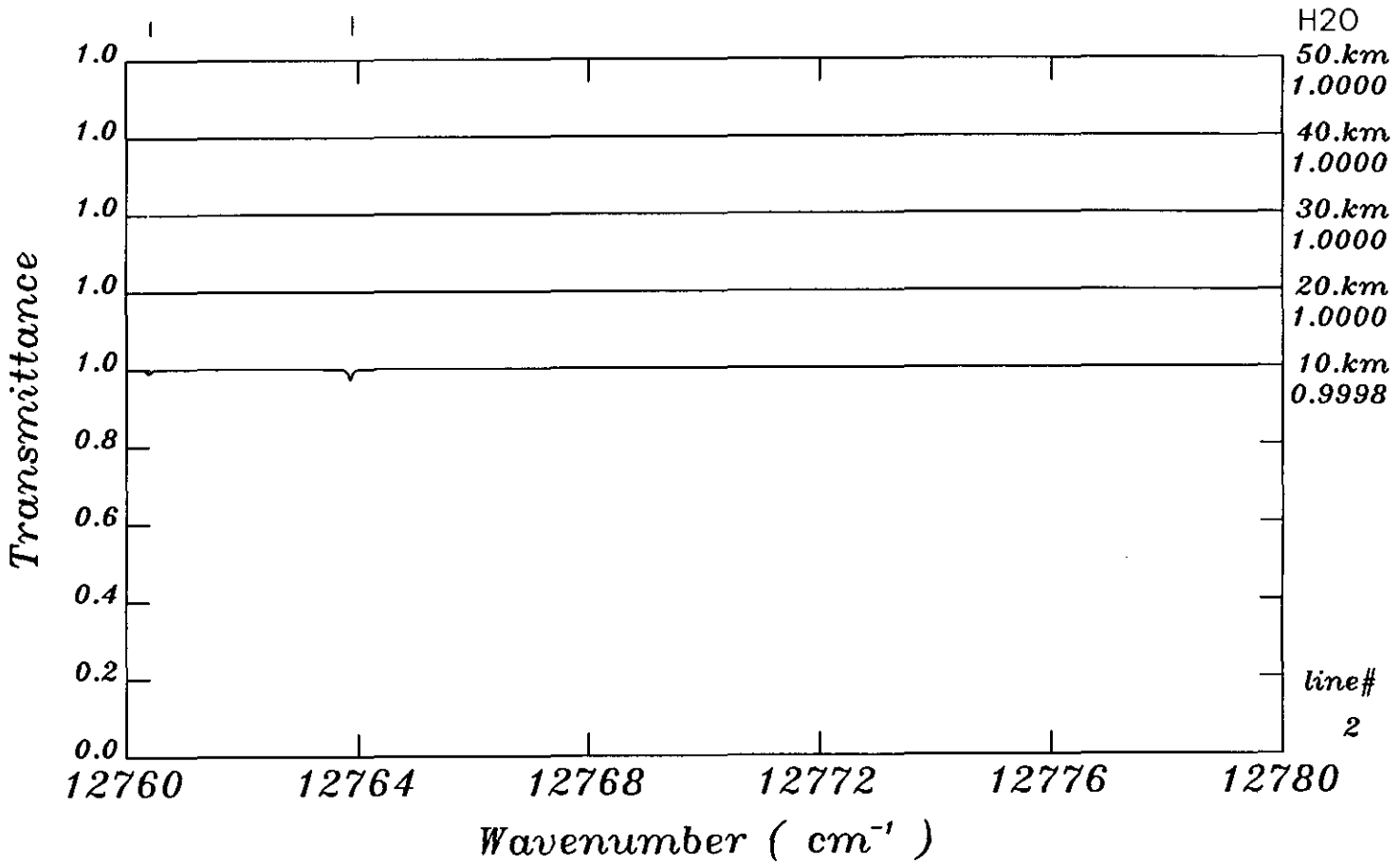

NO2
CH4
N2O
H2O
50.km
.99301
40.km
.97631
30.km
.89837
20.km
.64635
10.km
.00000
line#
315
Transmittance
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
1640
1642
1644
1646
1648
1650
Wavenumber (cm⁻¹)

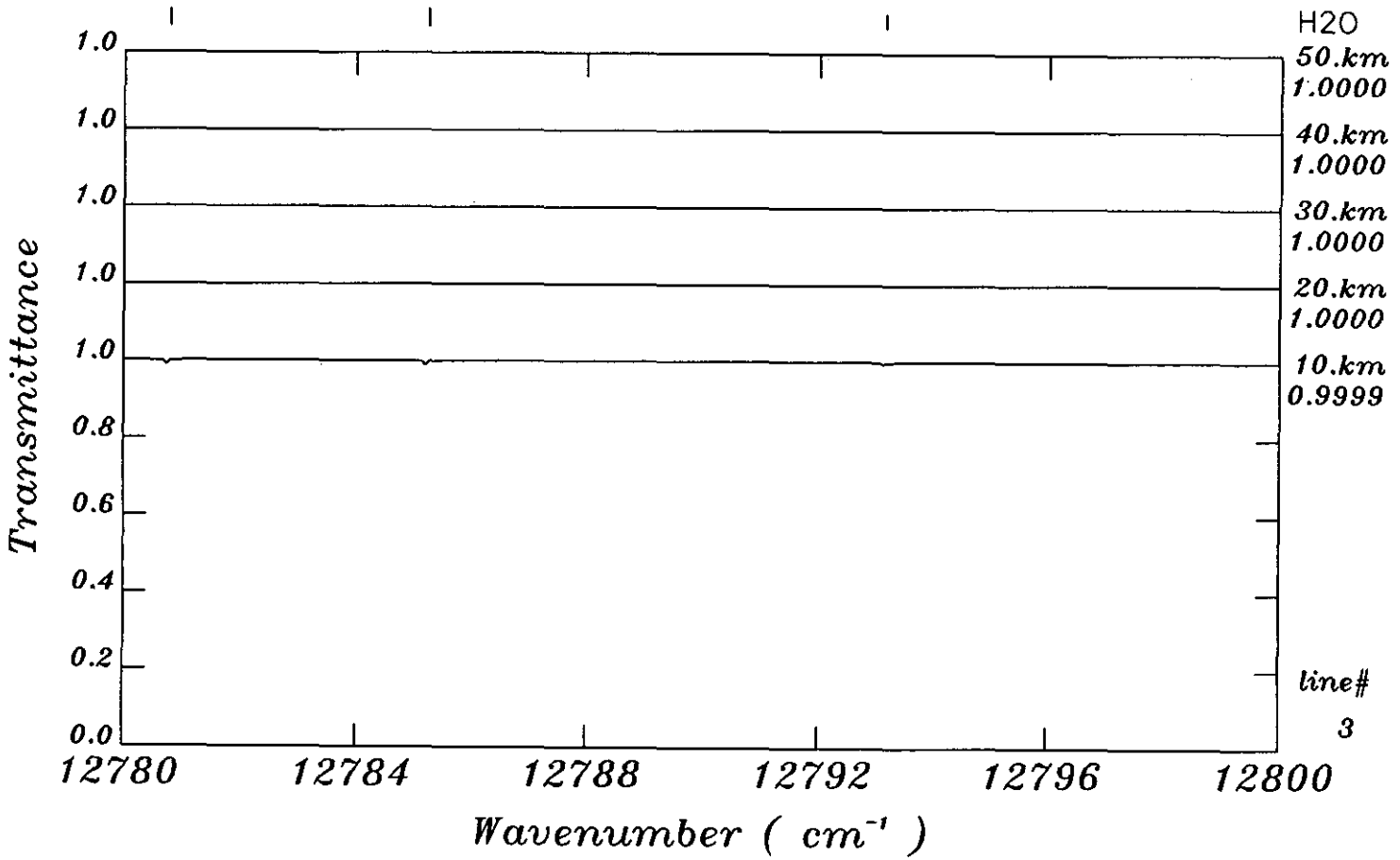
Atlas of the Visible O_2 Absorption Spectrum

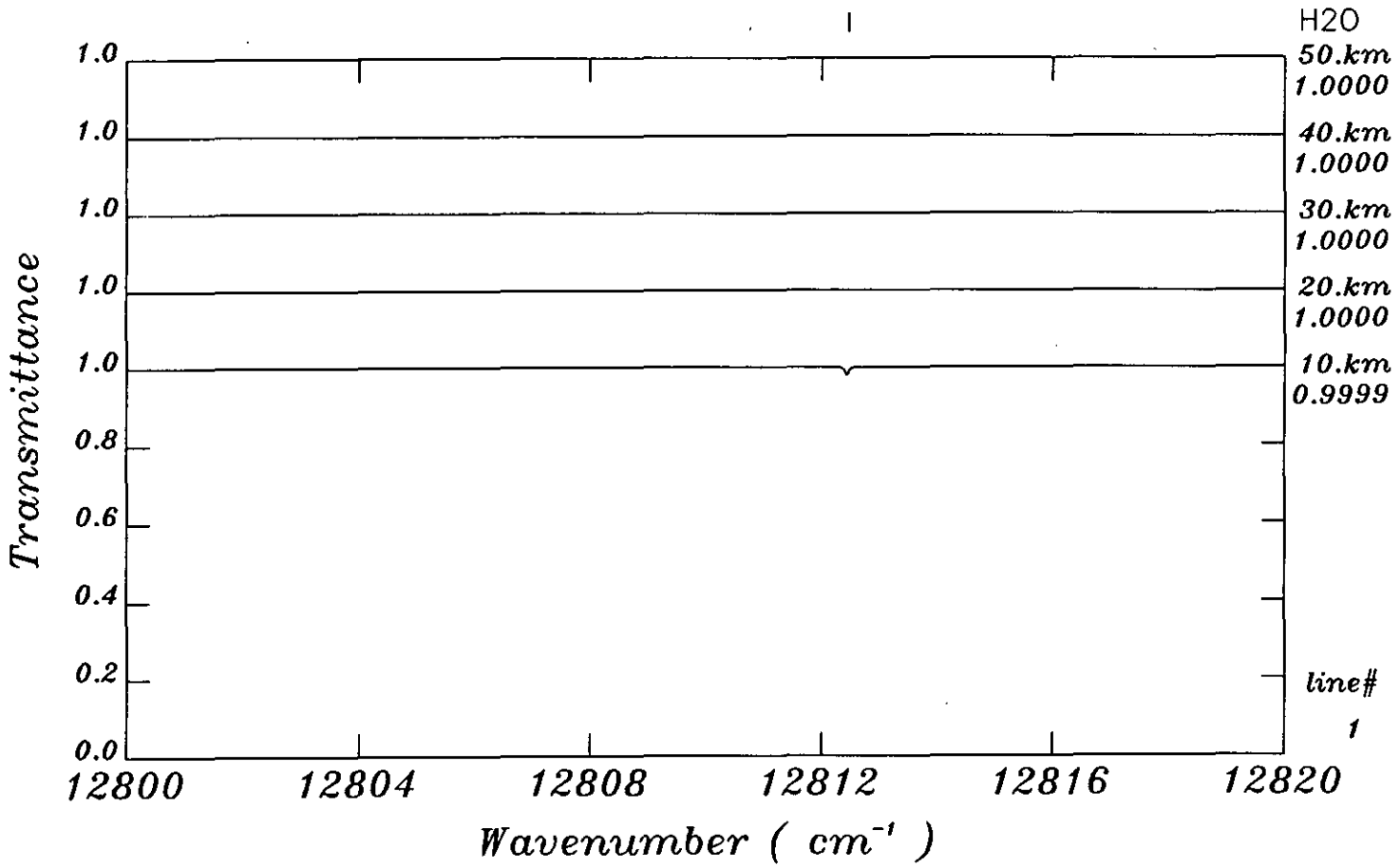
(Sample)

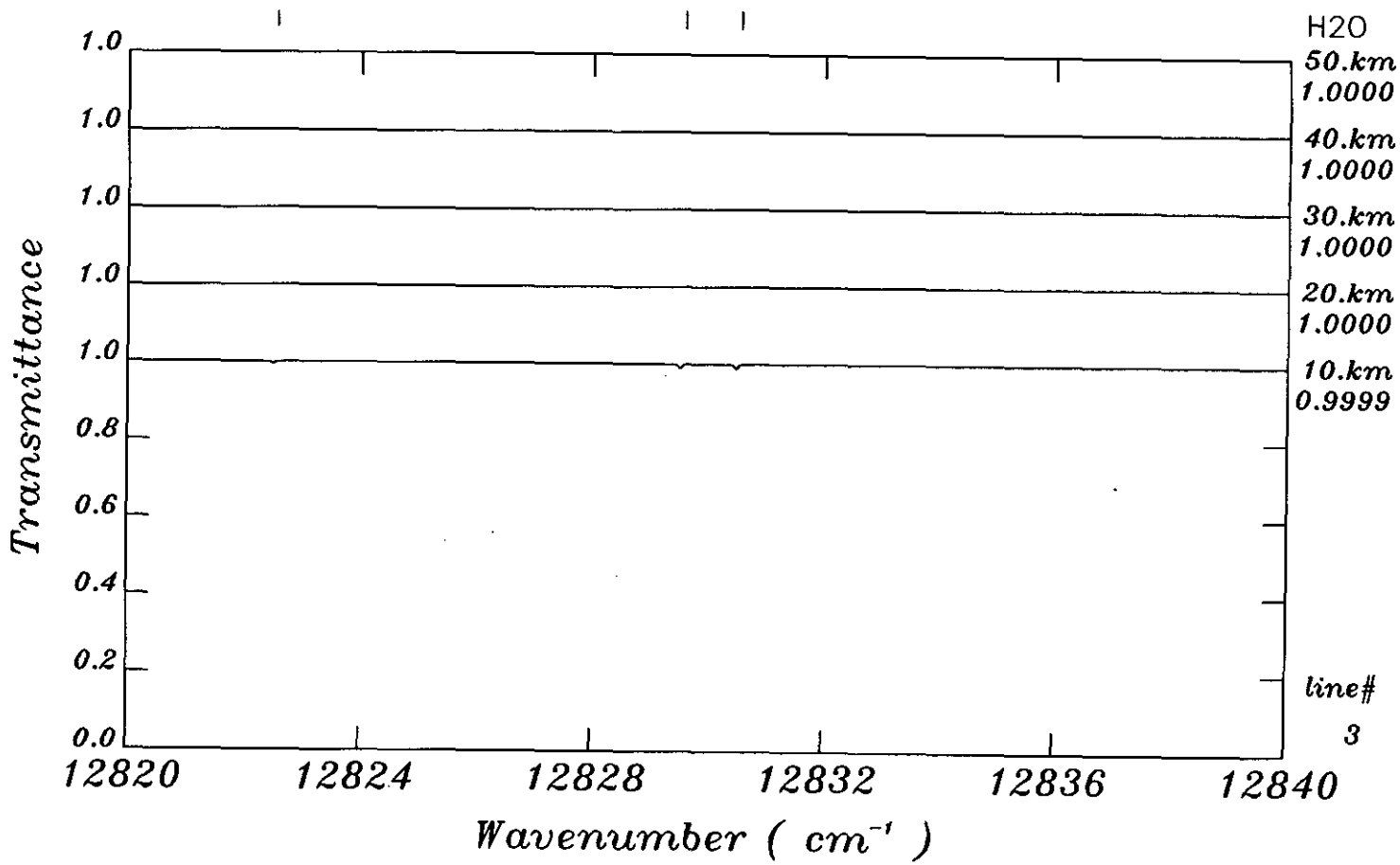

All line positions and strengths
02
H20
Two gases
50.km
1.0000
40.km
1.0000
30.km
0.9999
20.km
0.9998
10.km
0.9967
Averaged transmittance over the 20cm⁻¹ range (i.e. 12900~12920cm)
shift 0.2 each
Transmittance
1.0
0.8
0.6
0.4
0.2
0.0
for 10km
line#
10
Number of the total absorption lines in this chart
12900
12904
12908
12912
12916
12920
Wavenumber (cm⁻¹)

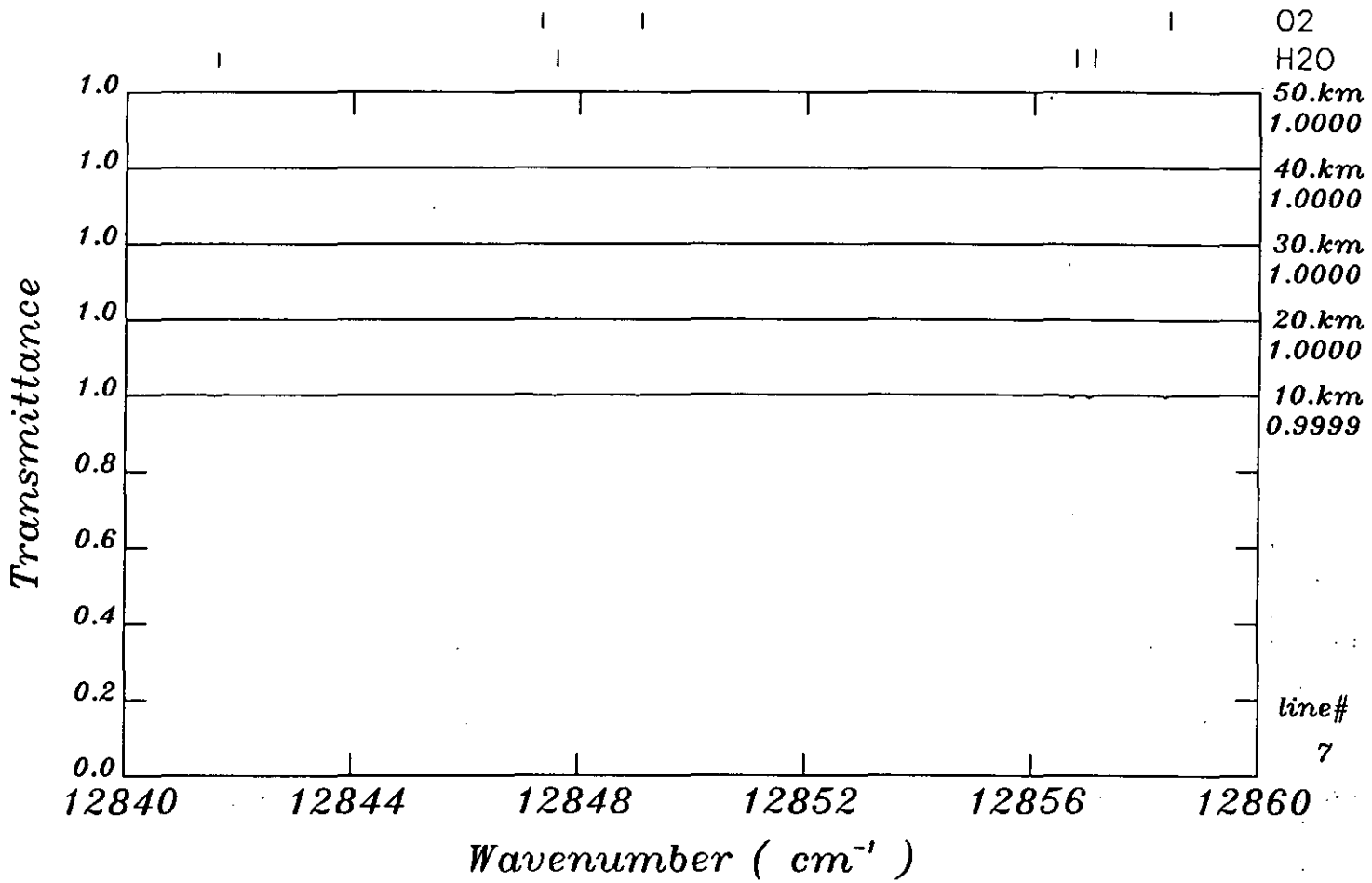

H2O
50.km
1.0000
40.km
1.0000
30.km
1.0000
20.km
1.0000
10.km
0.9996
line#
4
1.0
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
Transmittance
12740
12744
12748
12752
12756
12760
Wavenumber (cm⁻¹)

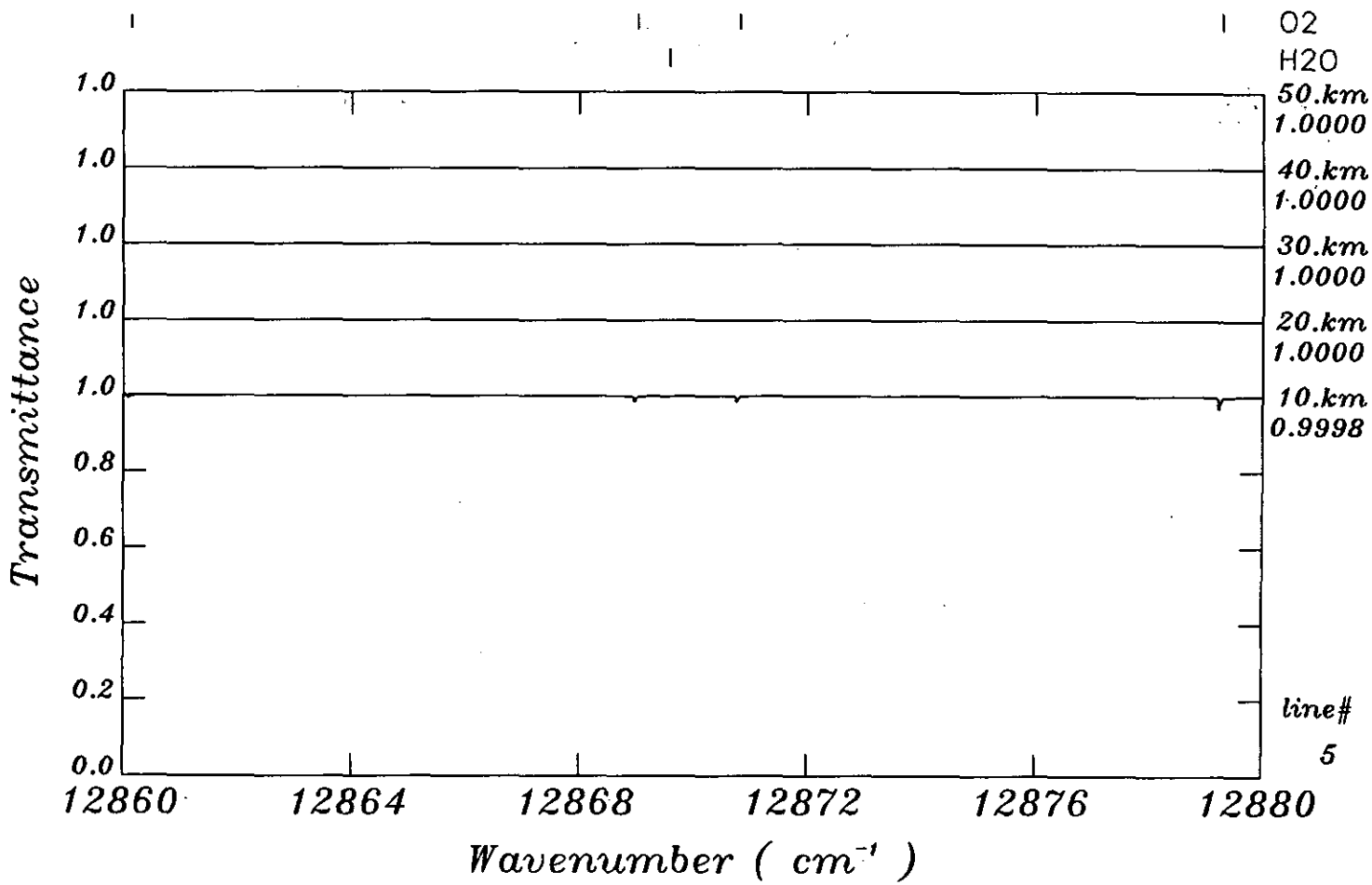

H2O
50.km
1.0000
40.km
1.0000
30.km
1.0000
20.km
1.0000
10.km
0.9998
line#
2
1.0
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
Transmittance
12760
12764
12768
12772
12776
12780
Wavenumber (cm⁻¹)

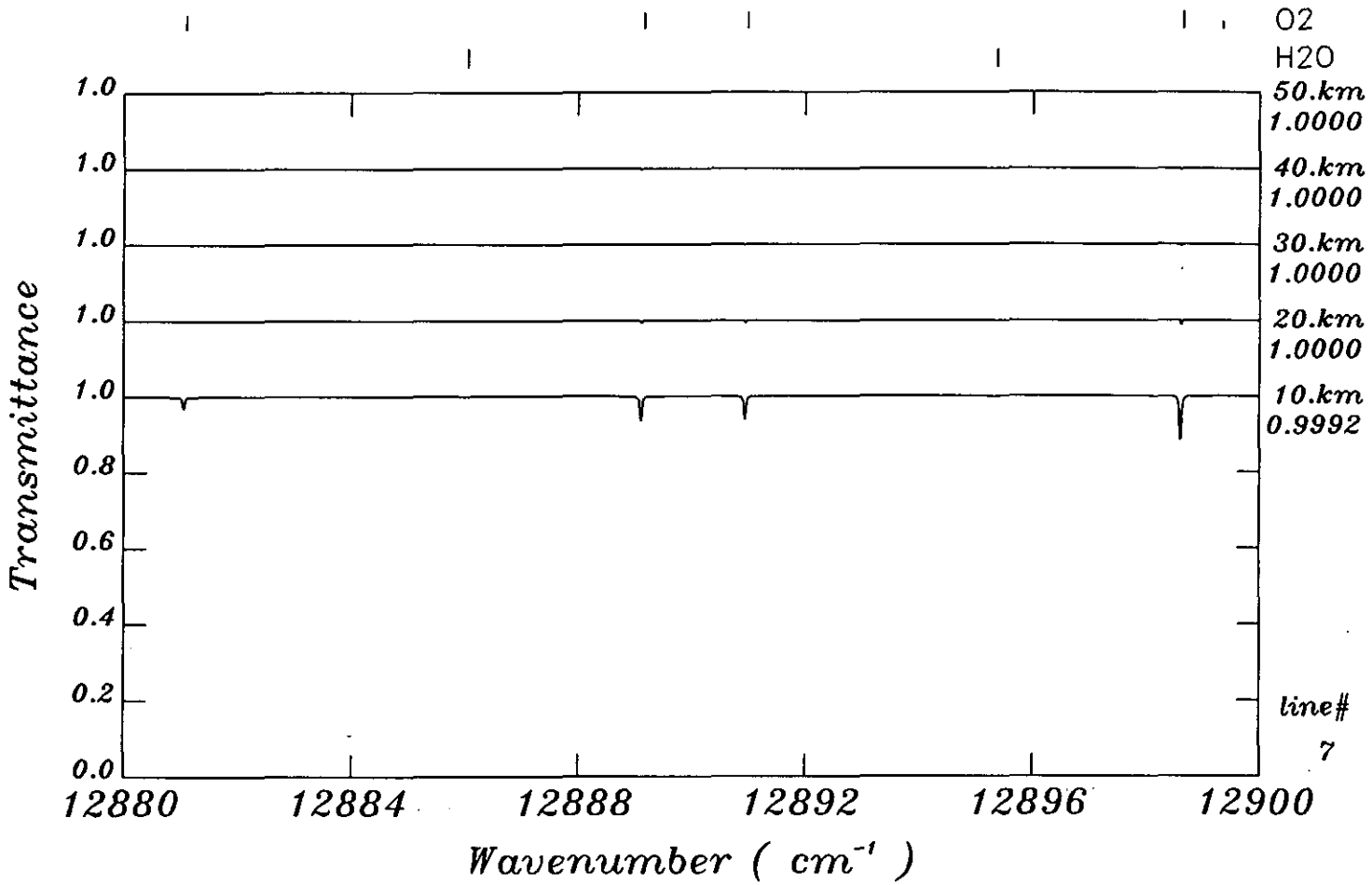

H2O
50.km
1.0000
40.km
1.0000
30.km
1.0000
20.km
1.0000
10.km
0.9999
line#
3
1.0
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
Transmittance
12780
12784
12788
12792
12796
12800
Wavenumber (cm⁻¹)

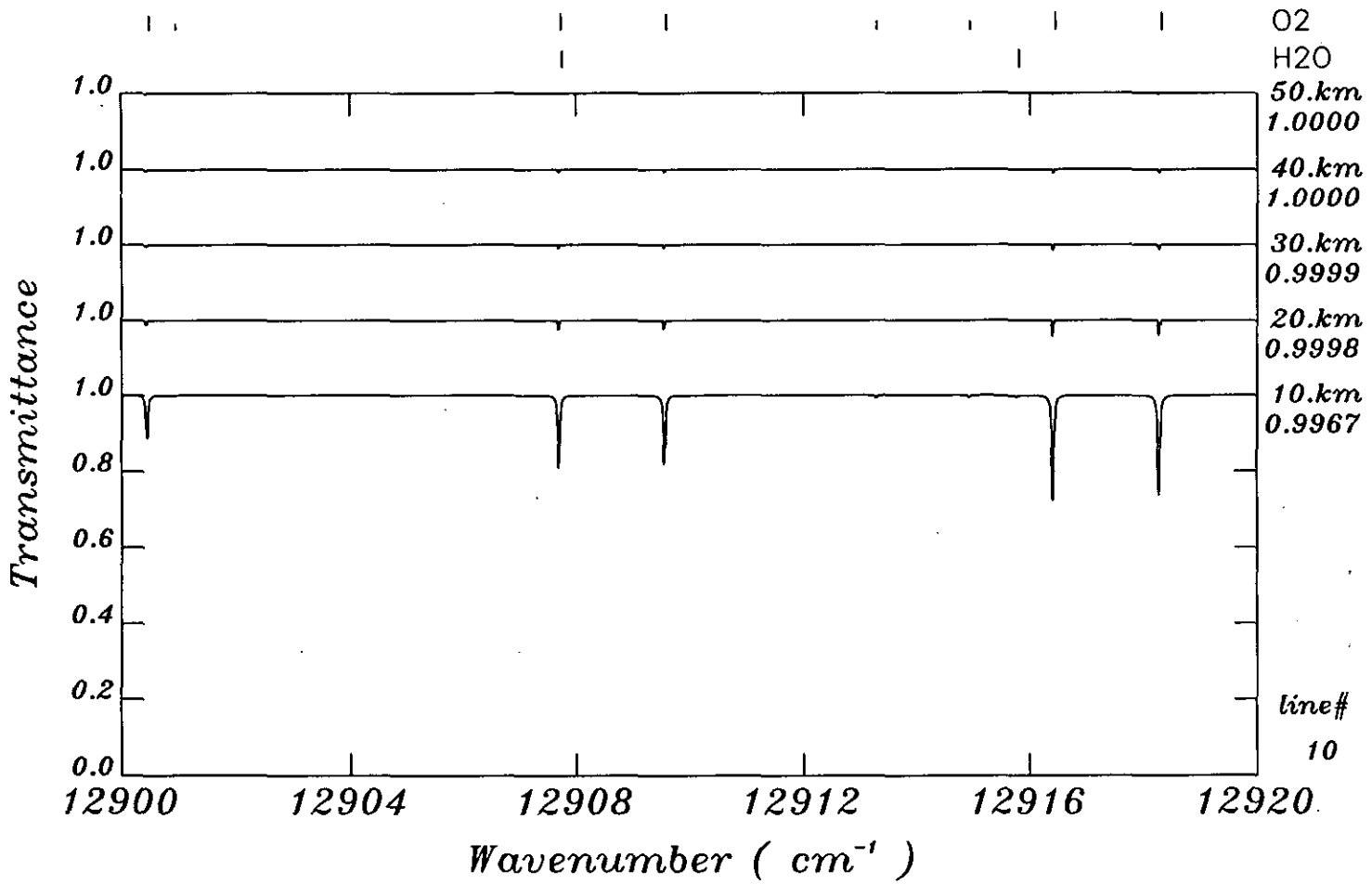

H2O
50.km
1.0000
40.km
1.0000
30.km
1.0000
20.km
1.0000
10.km
0.9999
line#
1
Transmittance
1.0
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
12800
12804
12808
12812
12816
12820
Wavenumber (cm⁻¹)

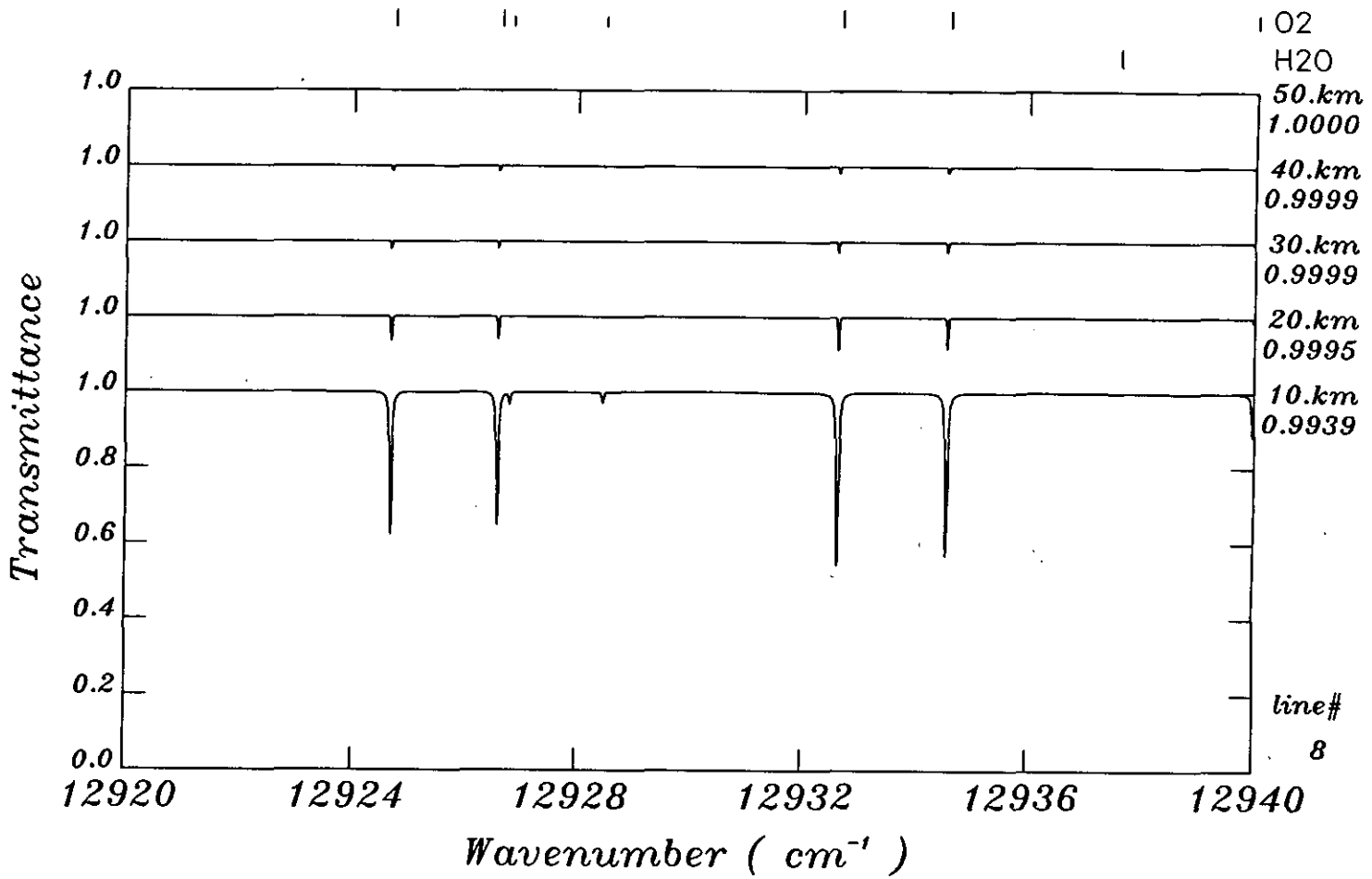

H2O
50.km
1.0000
40.km
1.0000
30.km
1.0000
20.km
1.0000
10.km
0.9999
line#
3
1.0
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
Transmittance
12820
12824
12828
12832
12836
12840
Wavenumber (cm⁻¹)

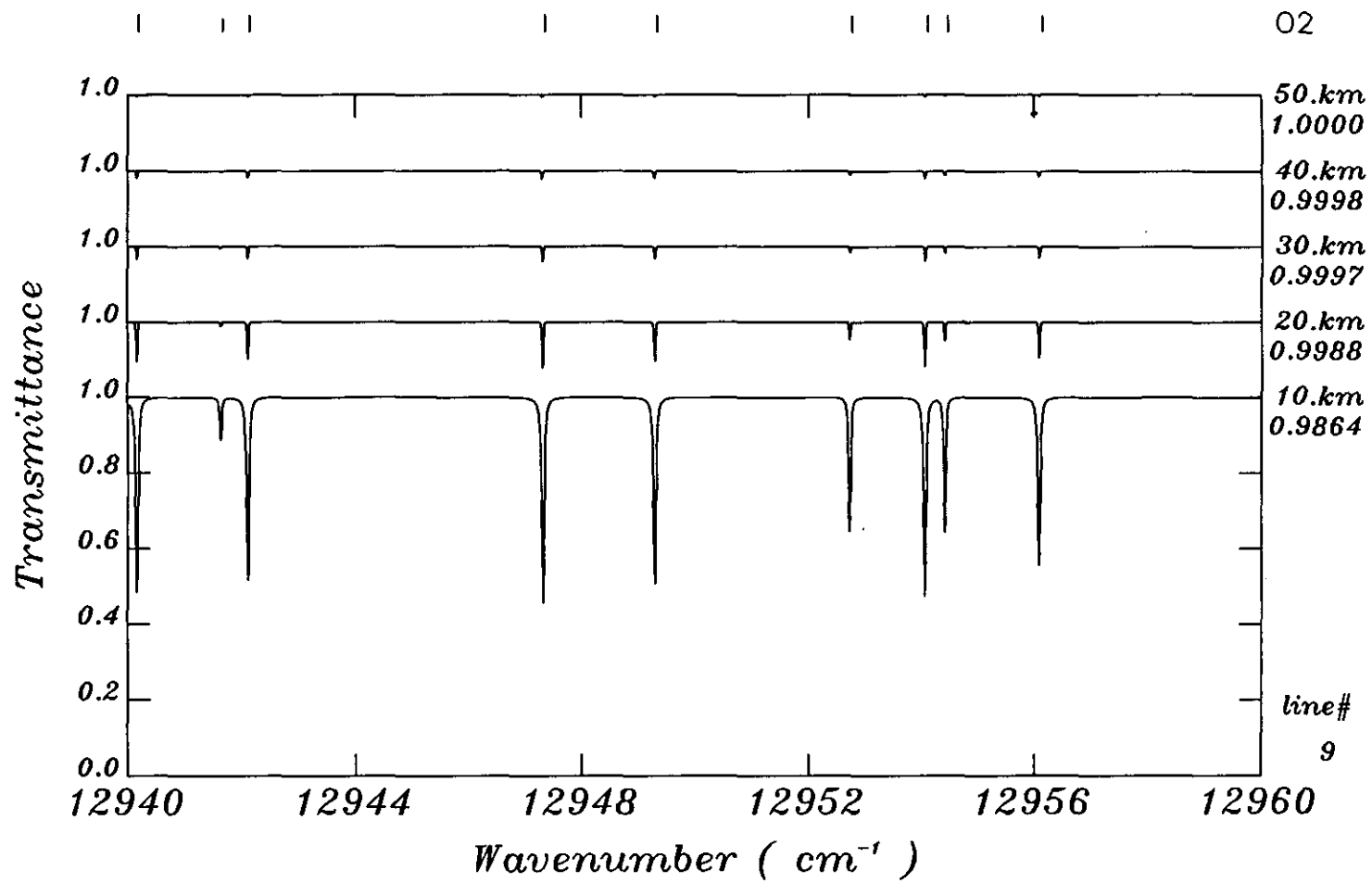

O2
H2O
50.km
1.0000
40.km
1.0000
30.km
1.0000
20.km
1.0000
10.km
0.9999
line#
7
Transmittance
1.0
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
12840
12844
12848
12852
12856
12860
Wavenumber (cm⁻¹)

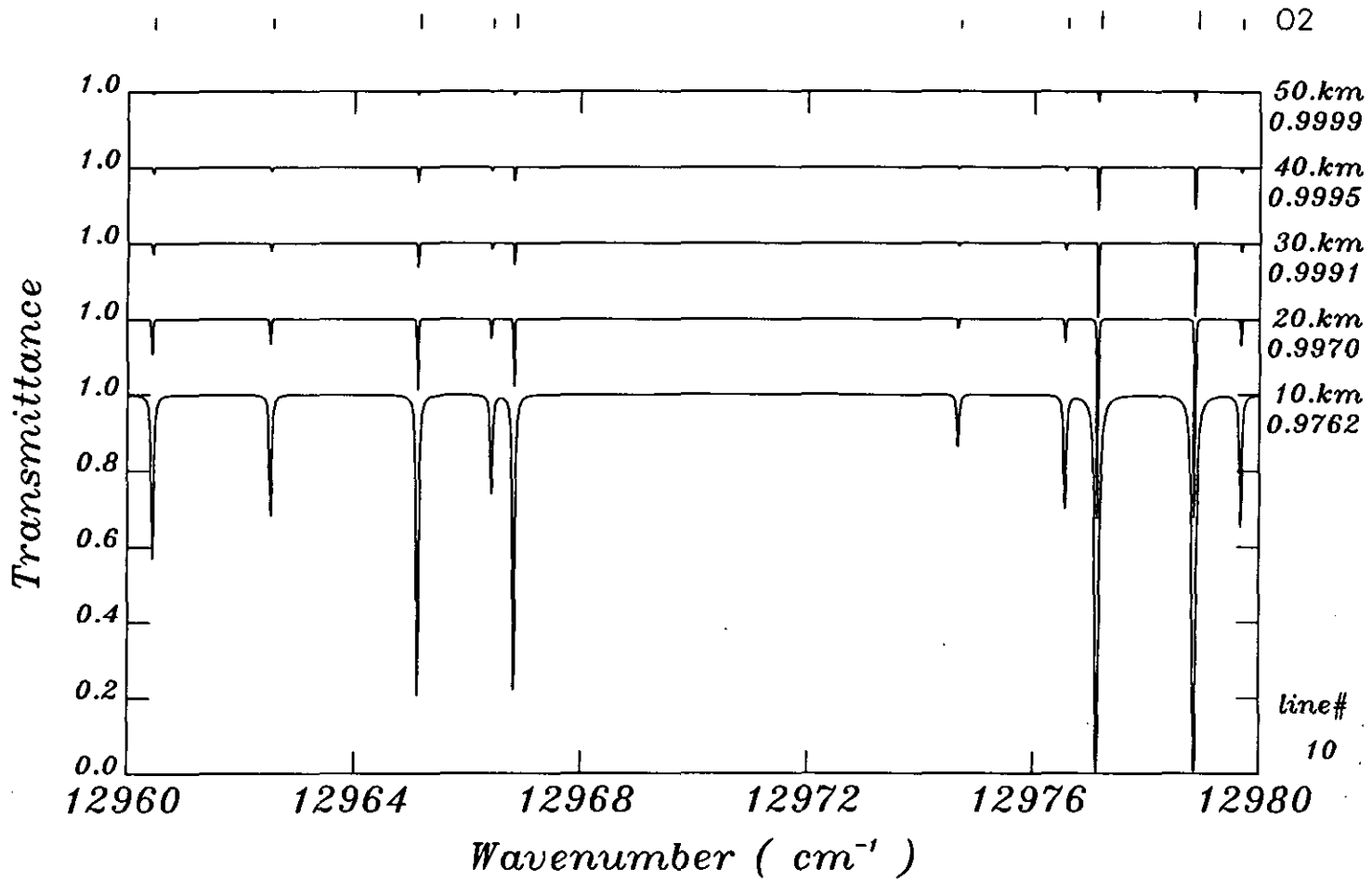

O2
H2O
50.km
1.0000
40.km
1.0000
30.km
1.0000
20.km
1.0000
10.km
0.9998
line#
5
1.0
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
Transmittance
12860
12864
12868
12872
12876
12880
Wavenumber (cm⁻¹)

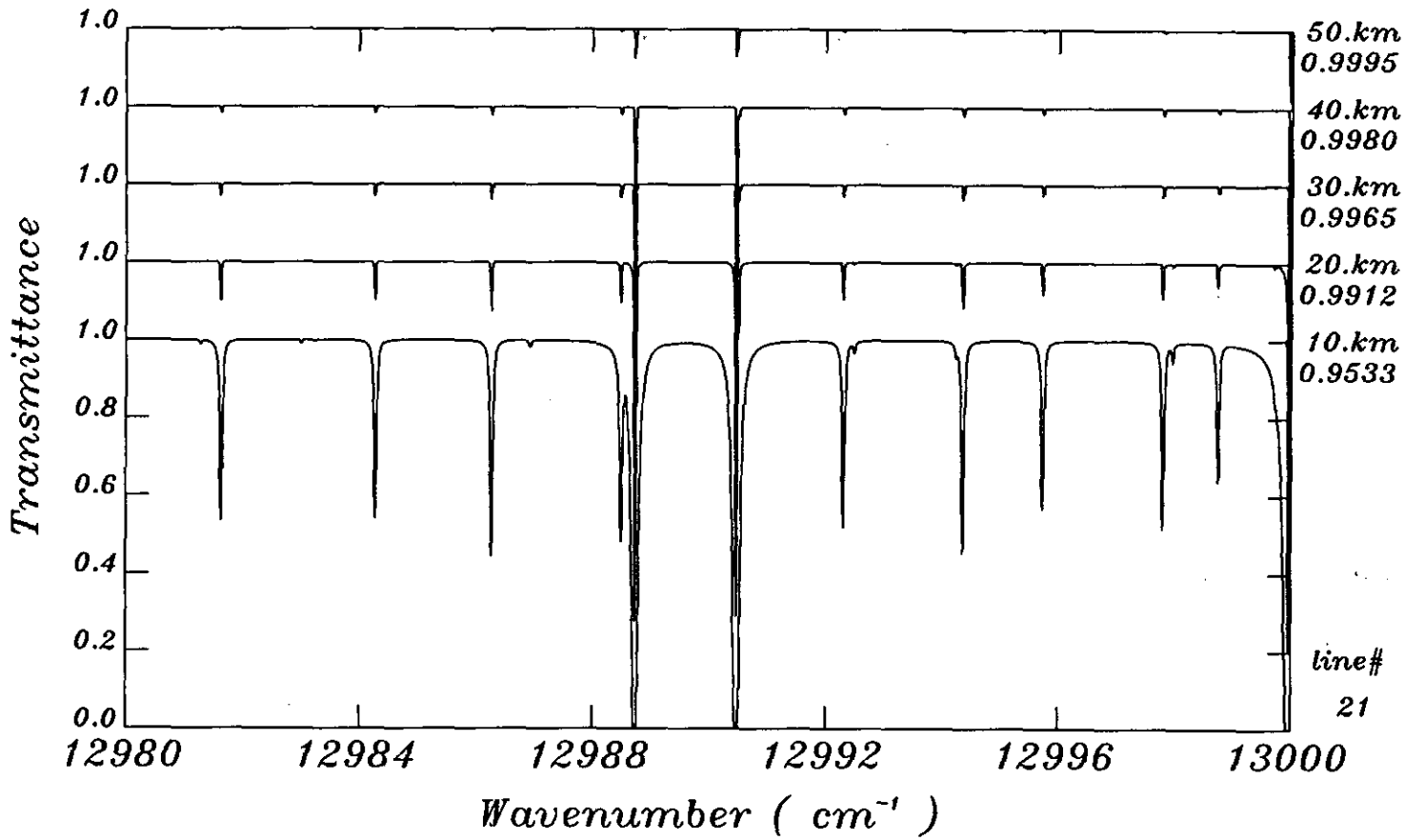

O2
H2O
50.km
1.0000
40.km
1.0000
30.km
1.0000
20.km
1.0000
10.km
0.9992
line#
7
Transmittance
1.0
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
12880
12884
12888
12892
12896
12900
Wavenumber (cm⁻¹)

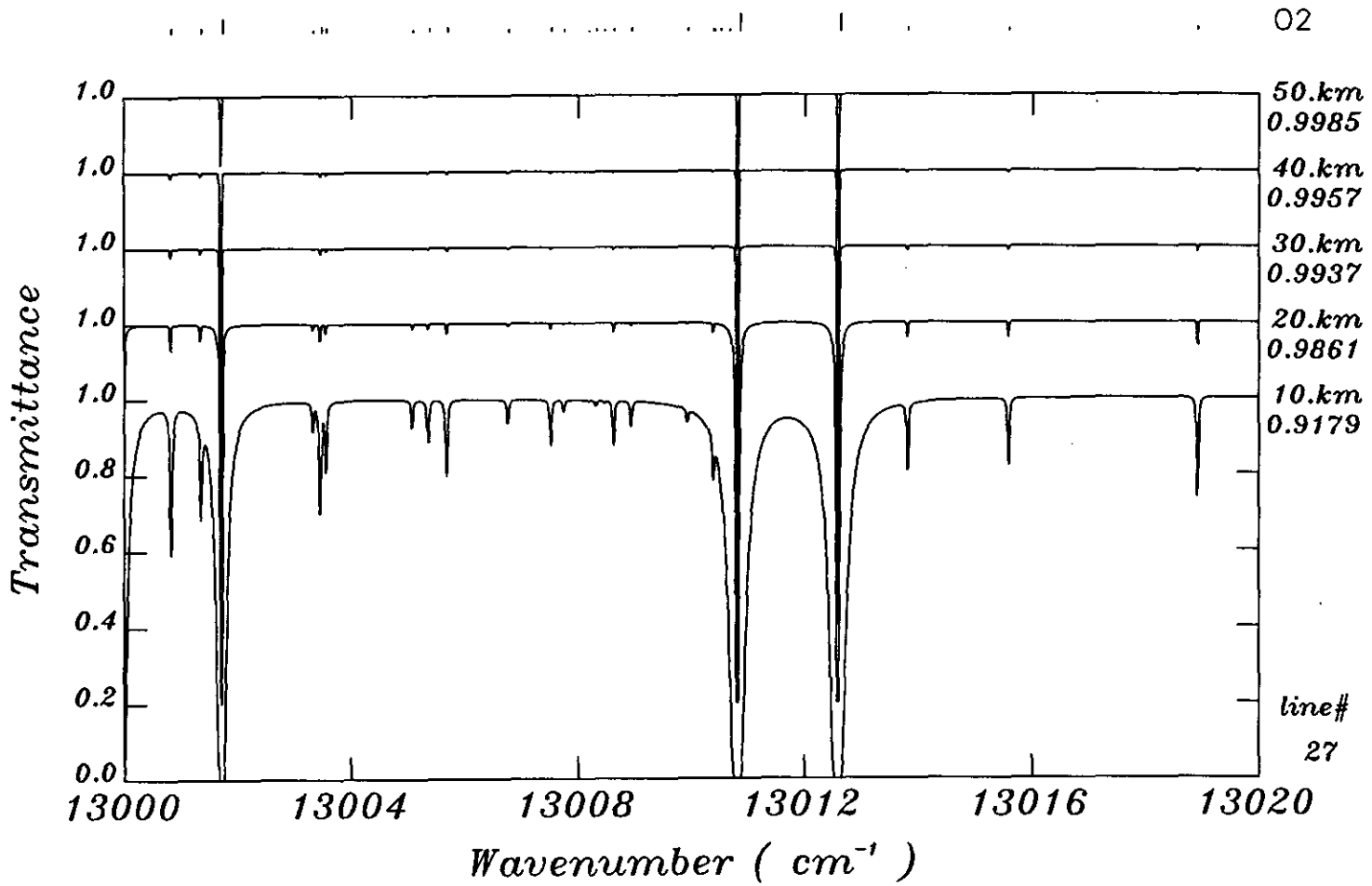

O2
H2O
50.km
1.0000
40.km
1.0000
30.km
0.9999
20.km
0.9998
10.km
0.9967
line#
10
Transmittance
1.0
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
12900
12904
12908
12912
12916
12920
Wavenumber (cm⁻¹)

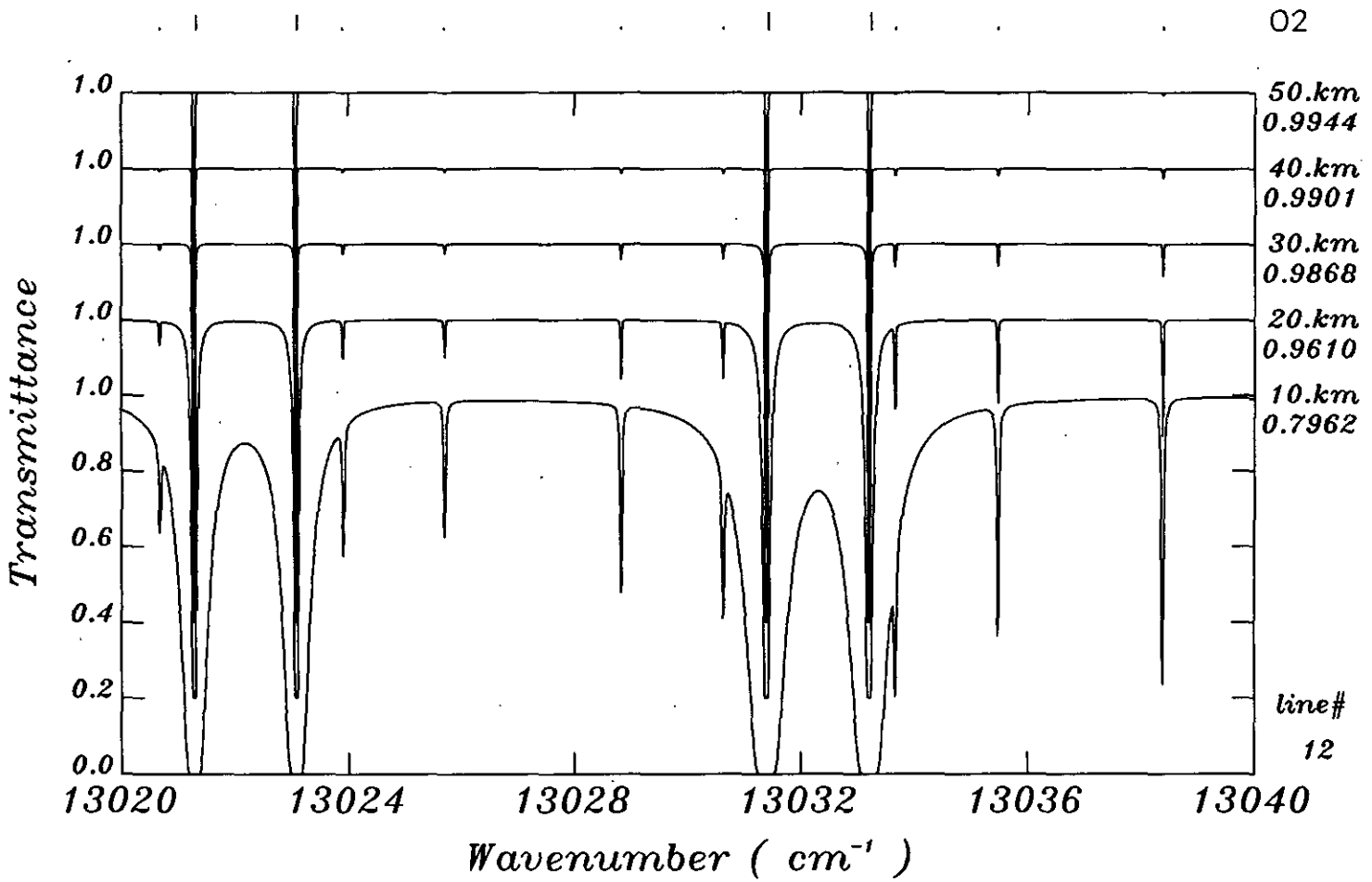

O2
H2O
50.km
1.0000
40.km
0.9999
30.km
0.9999
20.km
0.9995
10.km
0.9939
line#
8
Transmittance
1.0
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
12920
12924
12928
12932
12936
12940
Wavenumber (cm⁻¹)

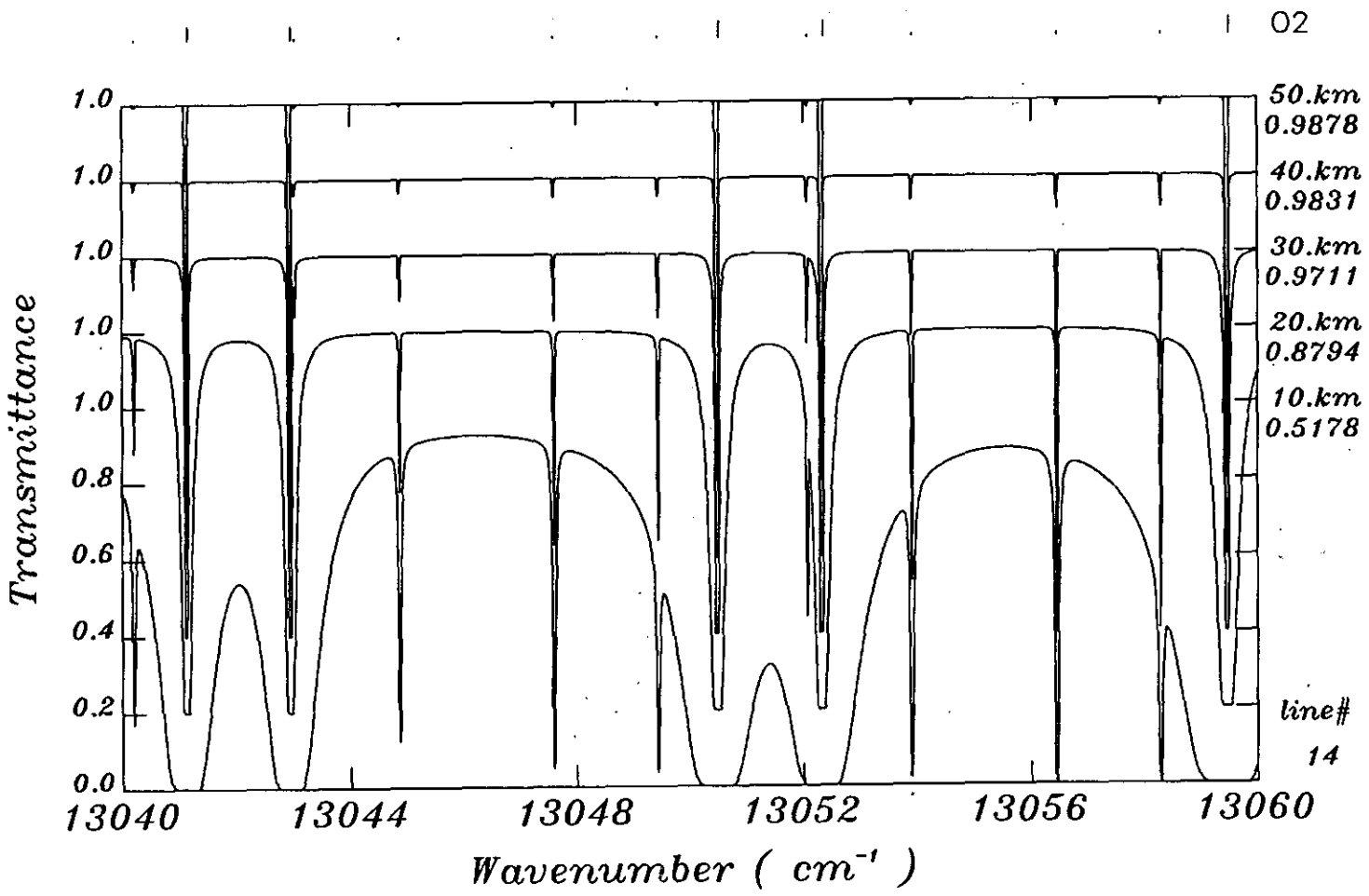

O2
50.km
1.0000
40.km
0.9998
30.km
0.9997
20.km
0.9988
10.km
0.9864
line#
9
Transmittance
1.0
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
12940
12944
12948
12952
12956
12960
Wavenumber (cm⁻¹)

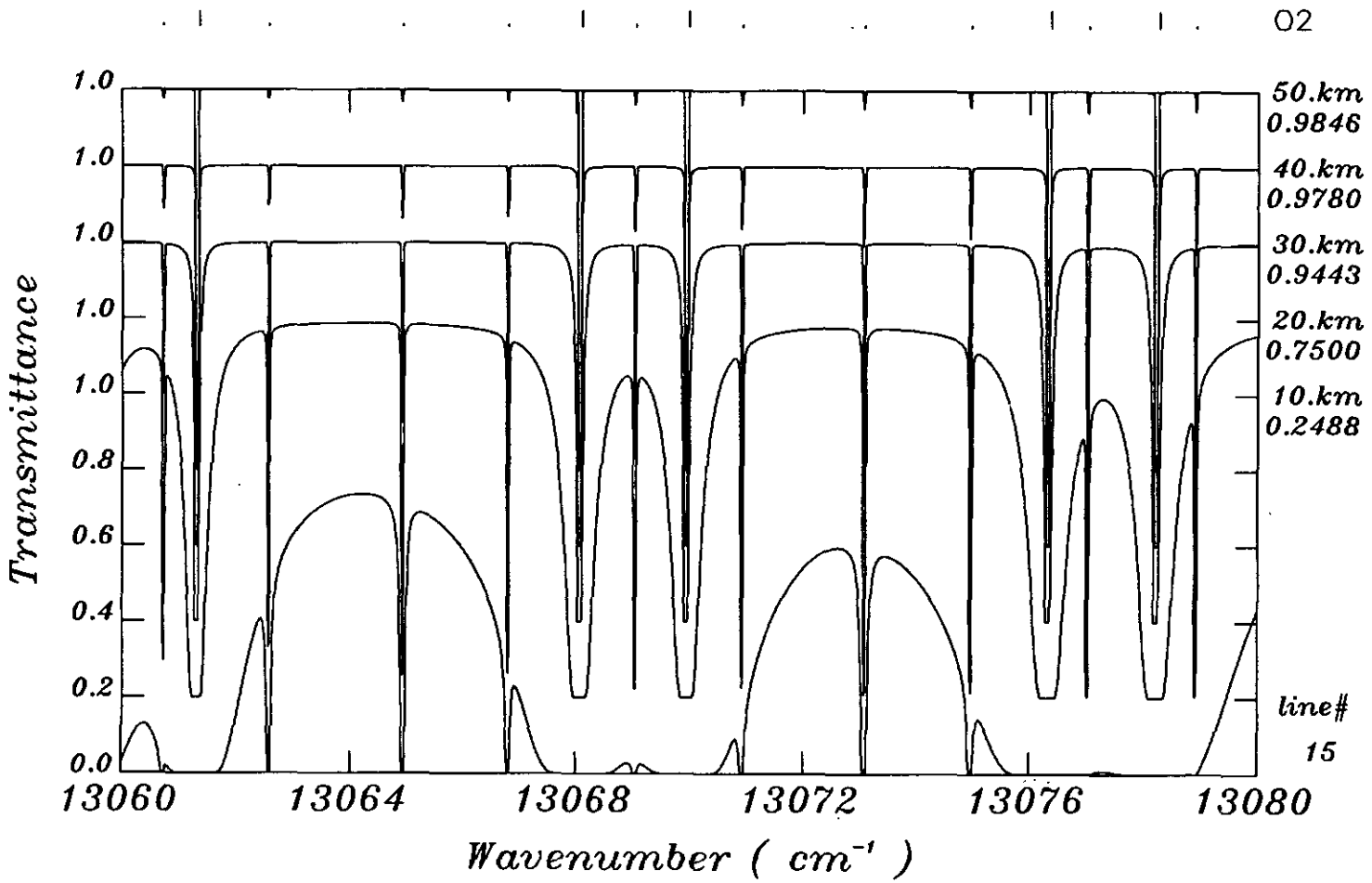

O2
1.0
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
Transmittance
50.km
0.9999
40.km
0.9995
30.km
0.9991
20.km
0.9970
10.km
0.9762
line#
10
12960
12964
12968
12972
12976
12980
Wavenumber (cm⁻¹)

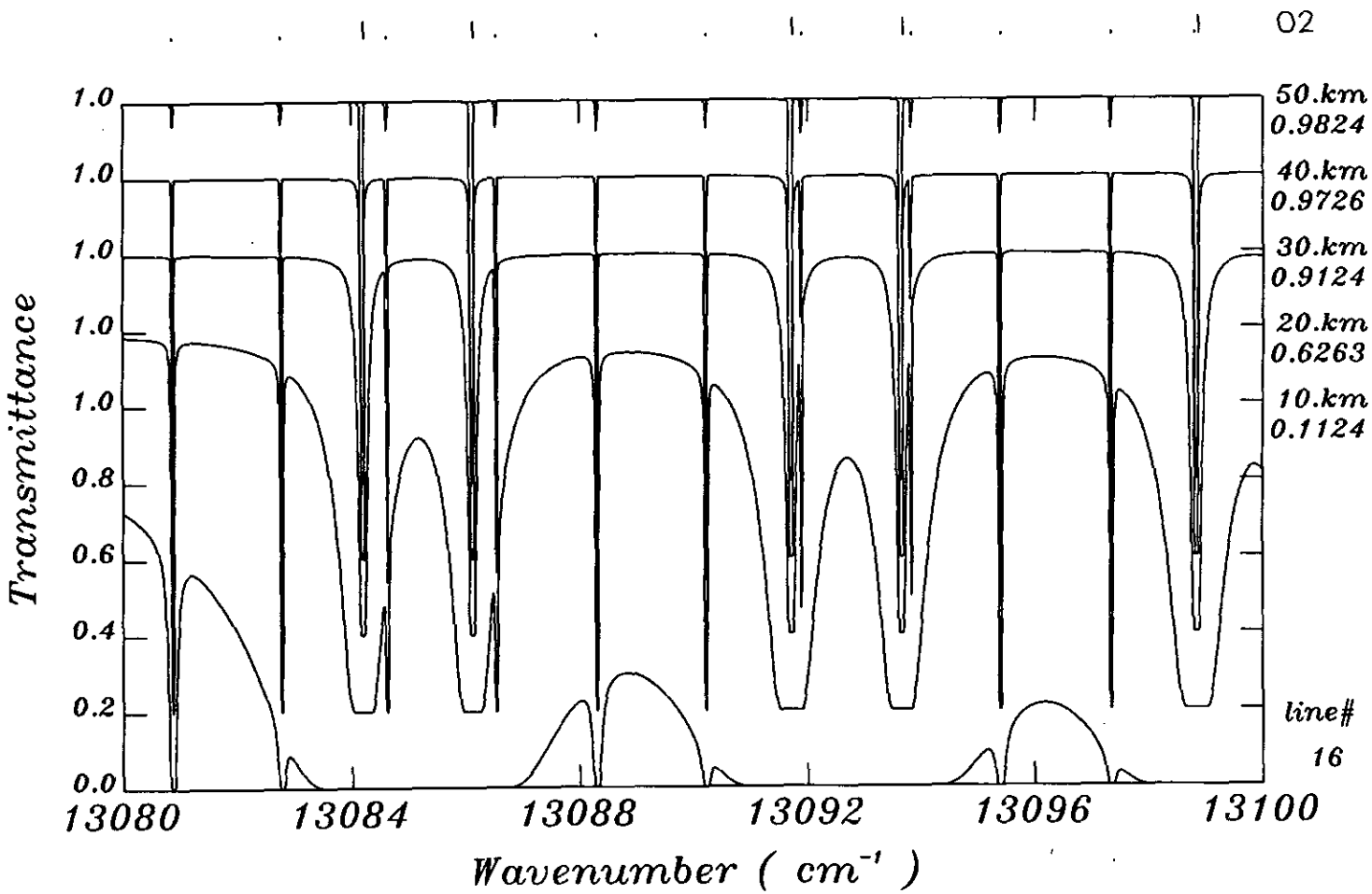

1.0
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
Transmittance
50.km
0.9995
40.km
0.9980
30.km
0.9965
20.km
0.9912
10.km
0.9533
line#
21
12980
12984
12988
12992
12996
13000
Wavenumber (cm⁻¹)

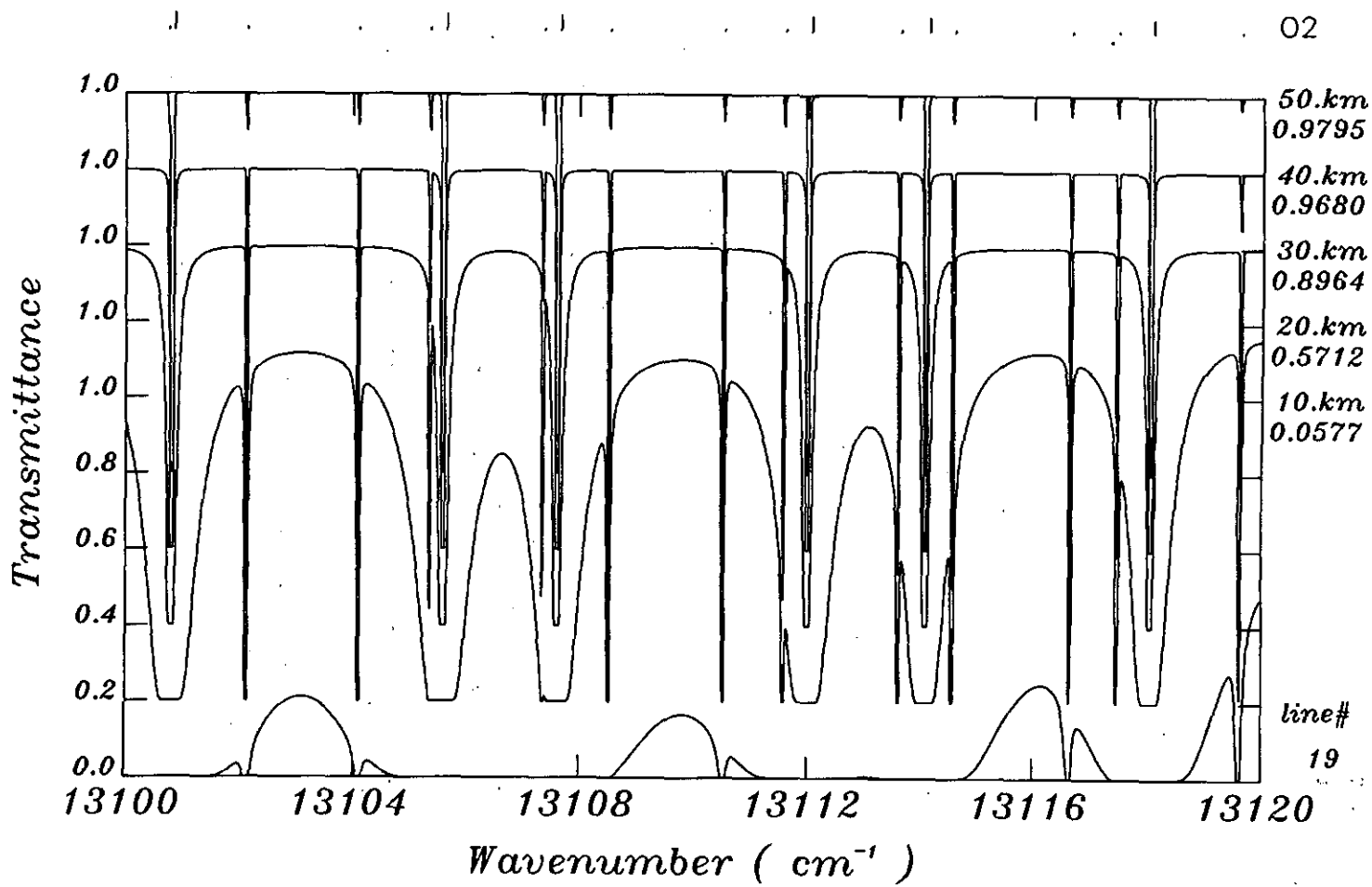

O2
50.km
0.9985
40.km
0.9957
30.km
0.9937
20.km
0.9861
10.km
0.9179
line#
27
Transmittance
1.0
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
13000
13004
13008
13012
13016
13020
Wavenumber (cm⁻¹)

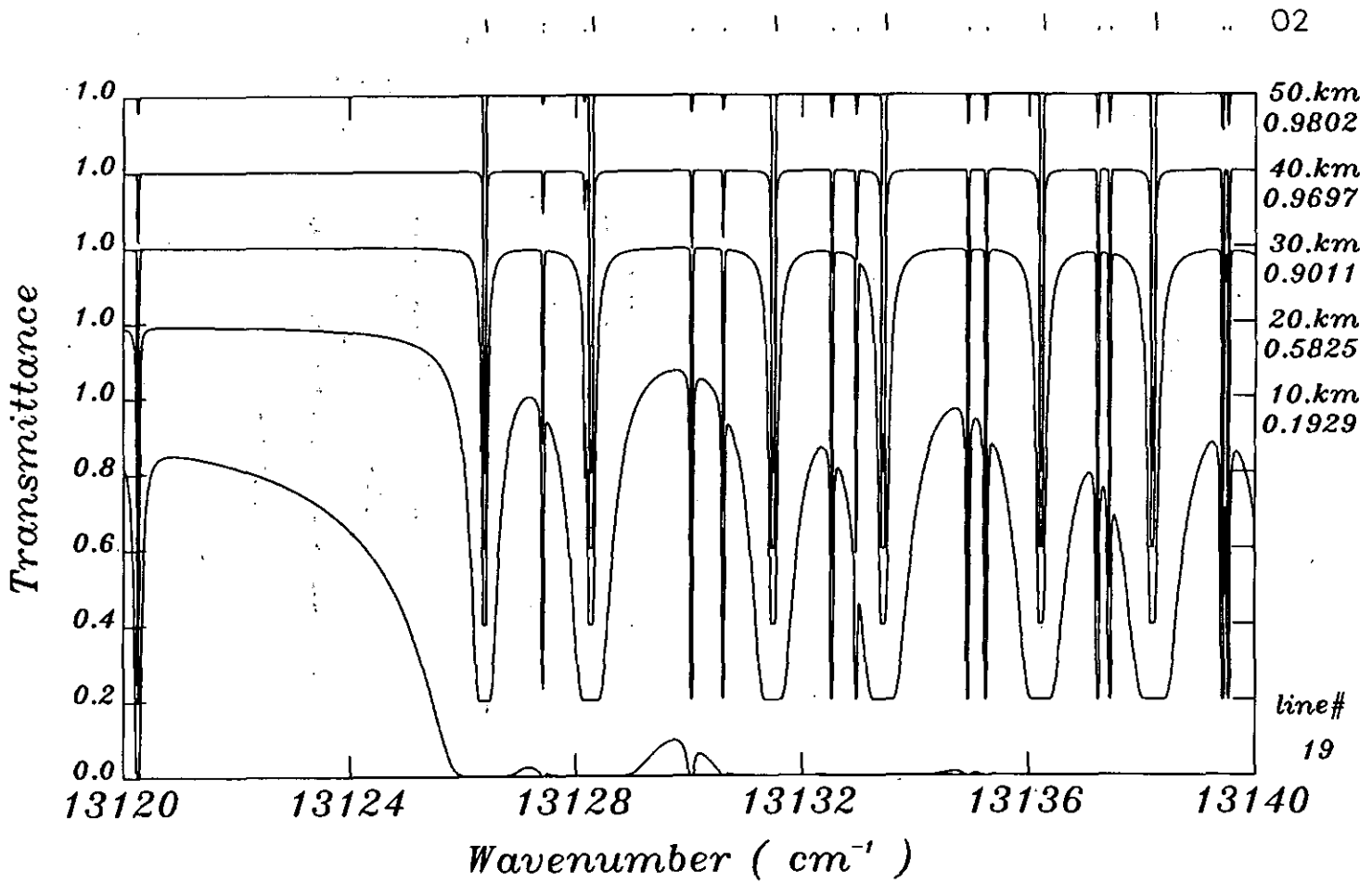

02
1.0
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
Transmittance
50.km
0.9944
40.km
0.9901
30.km
0.9868
20.km
0.9610
10.km
0.7962
line#
12
13020
13024
13028
13032
13036
13040
Wavenumber (cm⁻¹)

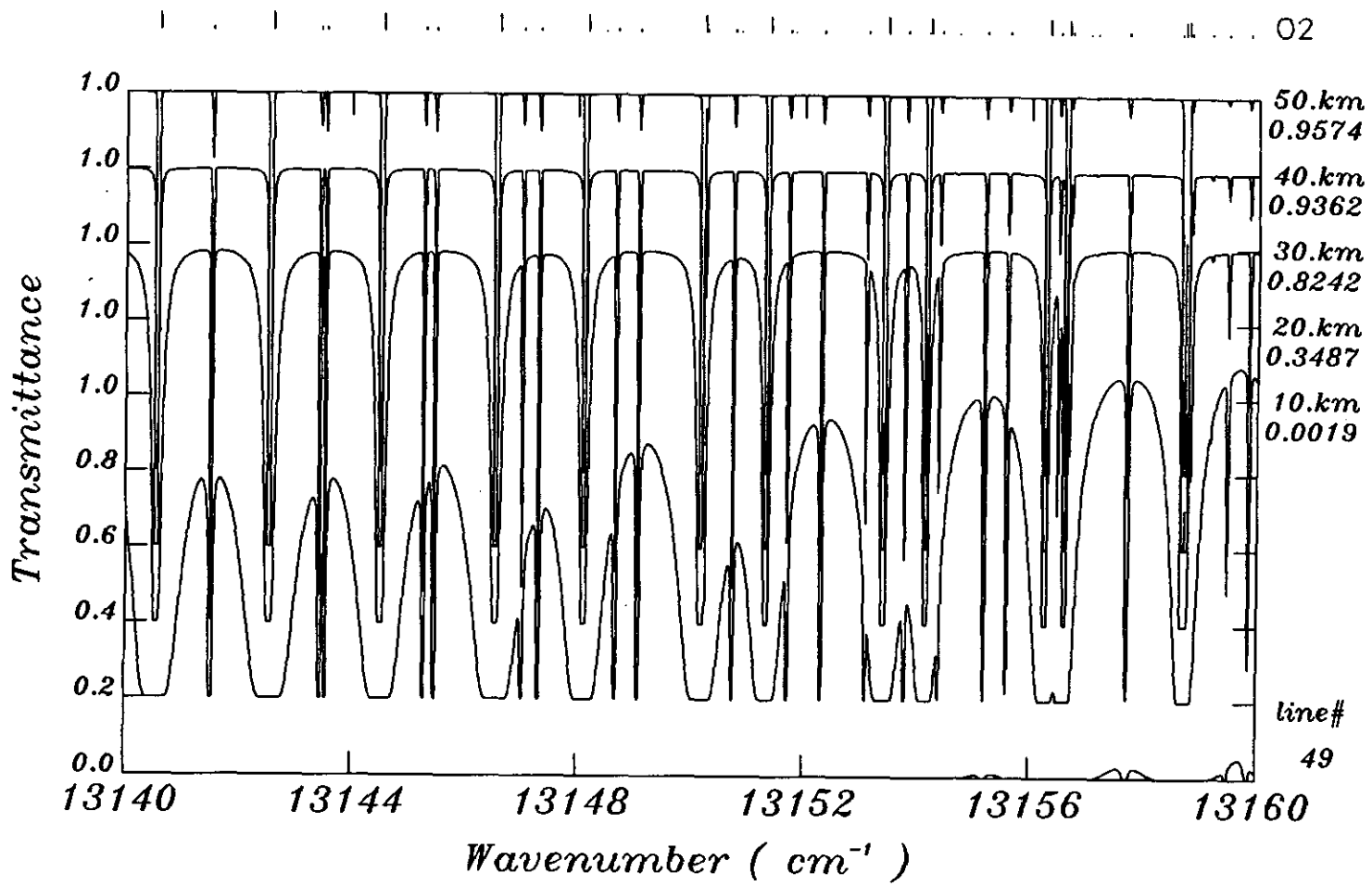

O2
Transmittance
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
50.km
0.9878
40.km
0.9831
30.km
0.9711
20.km
0.8794
10.km
0.5178
line#
14
13040
13044
13048
13052
13056
13060
Wavenumber (cm⁻¹)

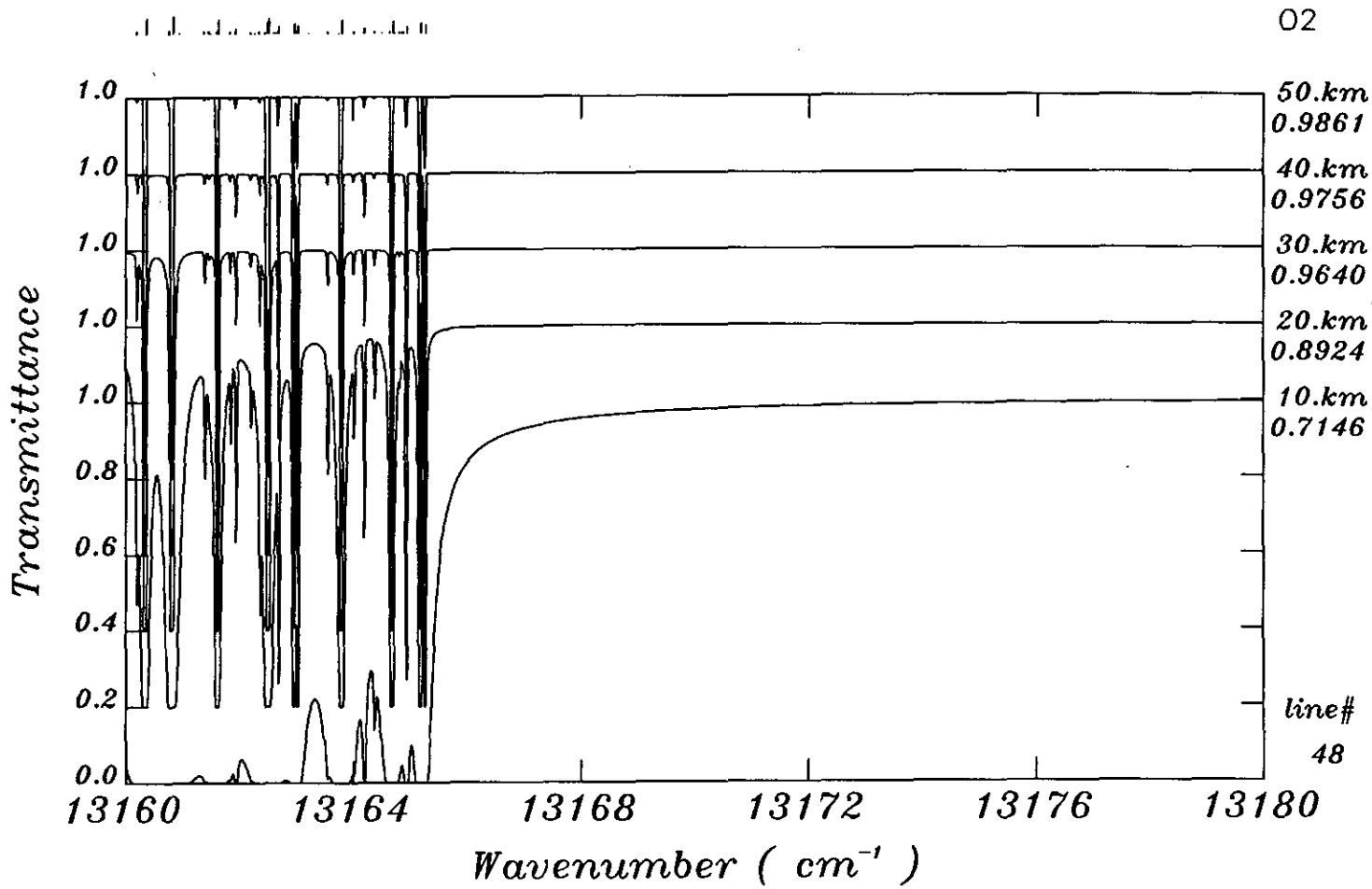

O2
1.0
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
Transmittance
50.km
0.9846
40.km
0.9780
30.km
0.9443
20.km
0.7500
10.km
0.2488
line#
15
13060
13064
13068
13072
13076
13080
Wavenumber (cm⁻¹)

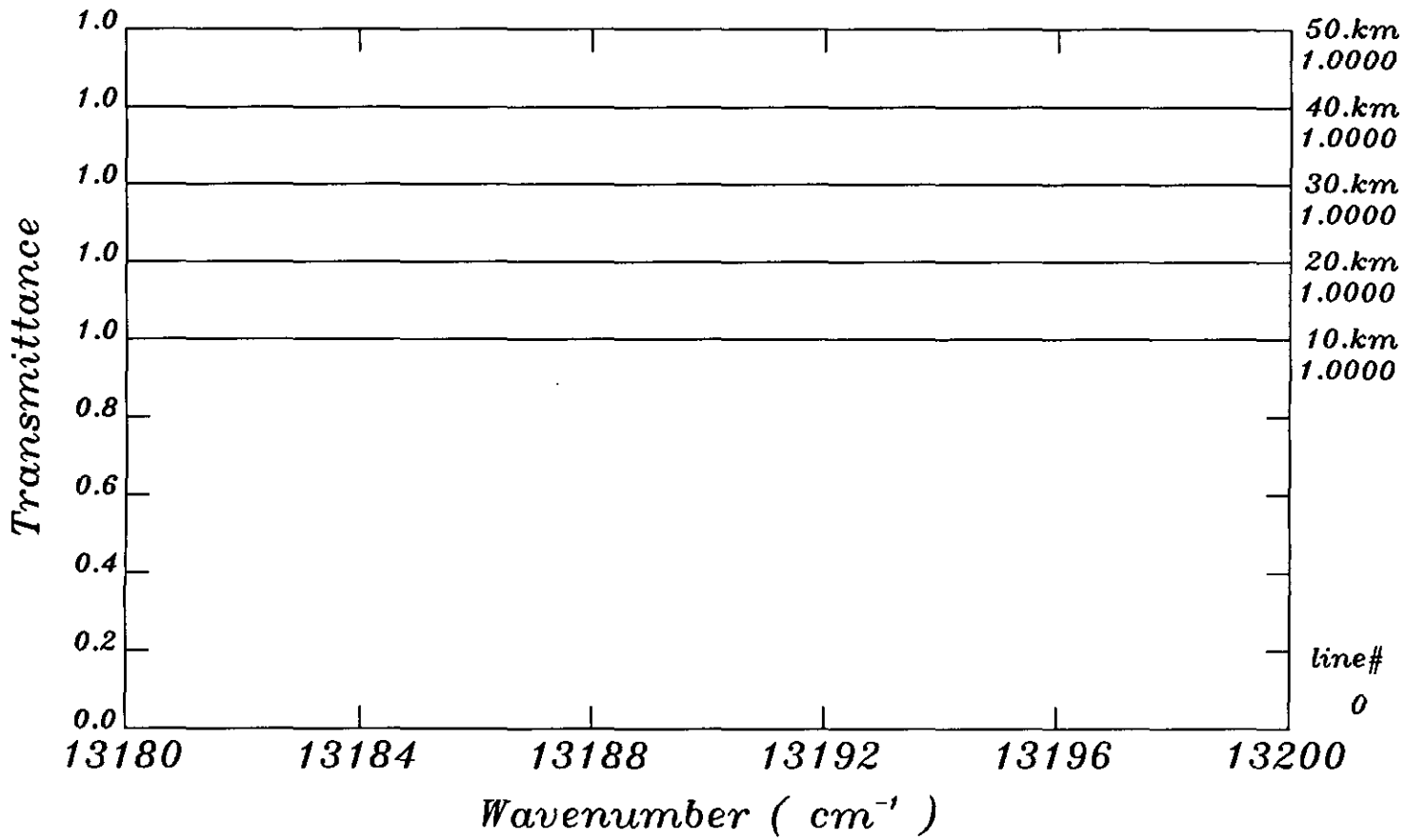

02
Transmittance
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
50.km
0.9824
40.km
0.9726
30.km
0.9124
20.km
0.6263
10.km
0.1124
line#
16
13080
13084
13088
13092
13096
13100
Wavenumber (cm⁻¹)

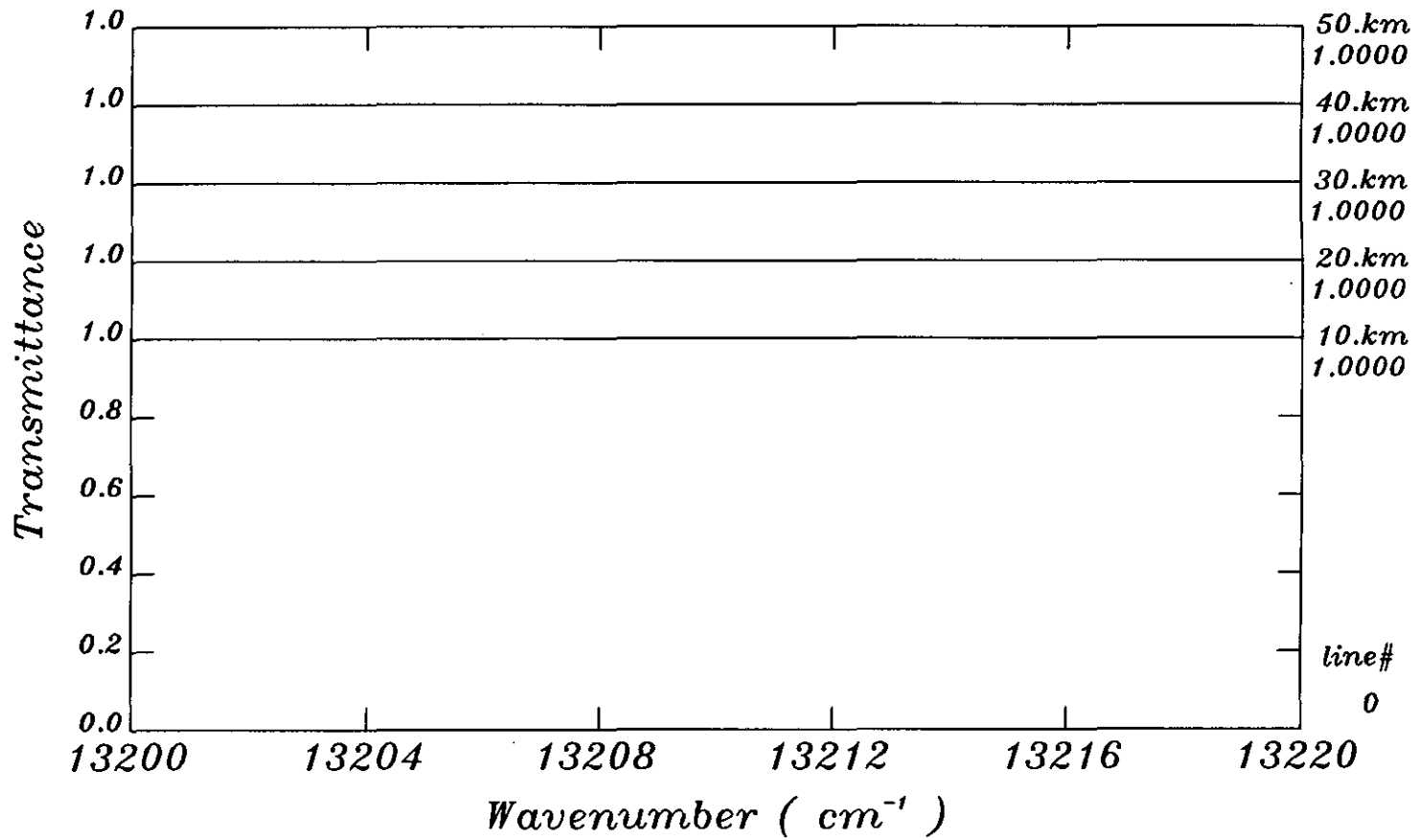

O2
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
Transmittance
50.km
0.9795
40.km
0.9680
30.km
0.8964
20.km
0.5712
10.km
0.0577
line#
19
13100
13104
13108
13112
13116
13120
Wavenumber (cm⁻¹)

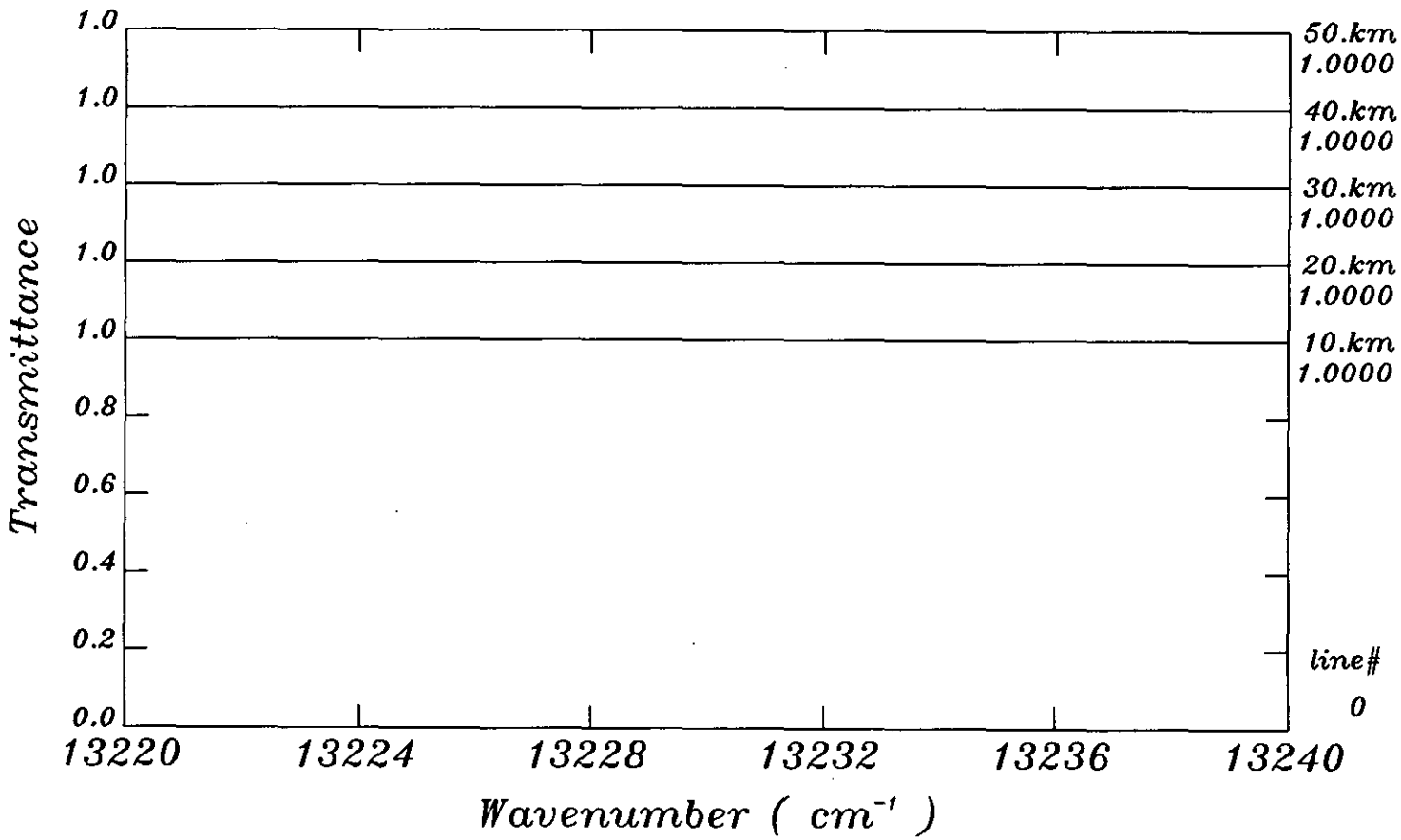

02
1.0
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
Transmittance
50.km
0.9802
40.km
0.9697
30.km
0.9011
20.km
0.5825
10.km
0.1929
line#
19
13120
13124
13128
13132
13136
13140
Wavenumber (cm⁻¹)

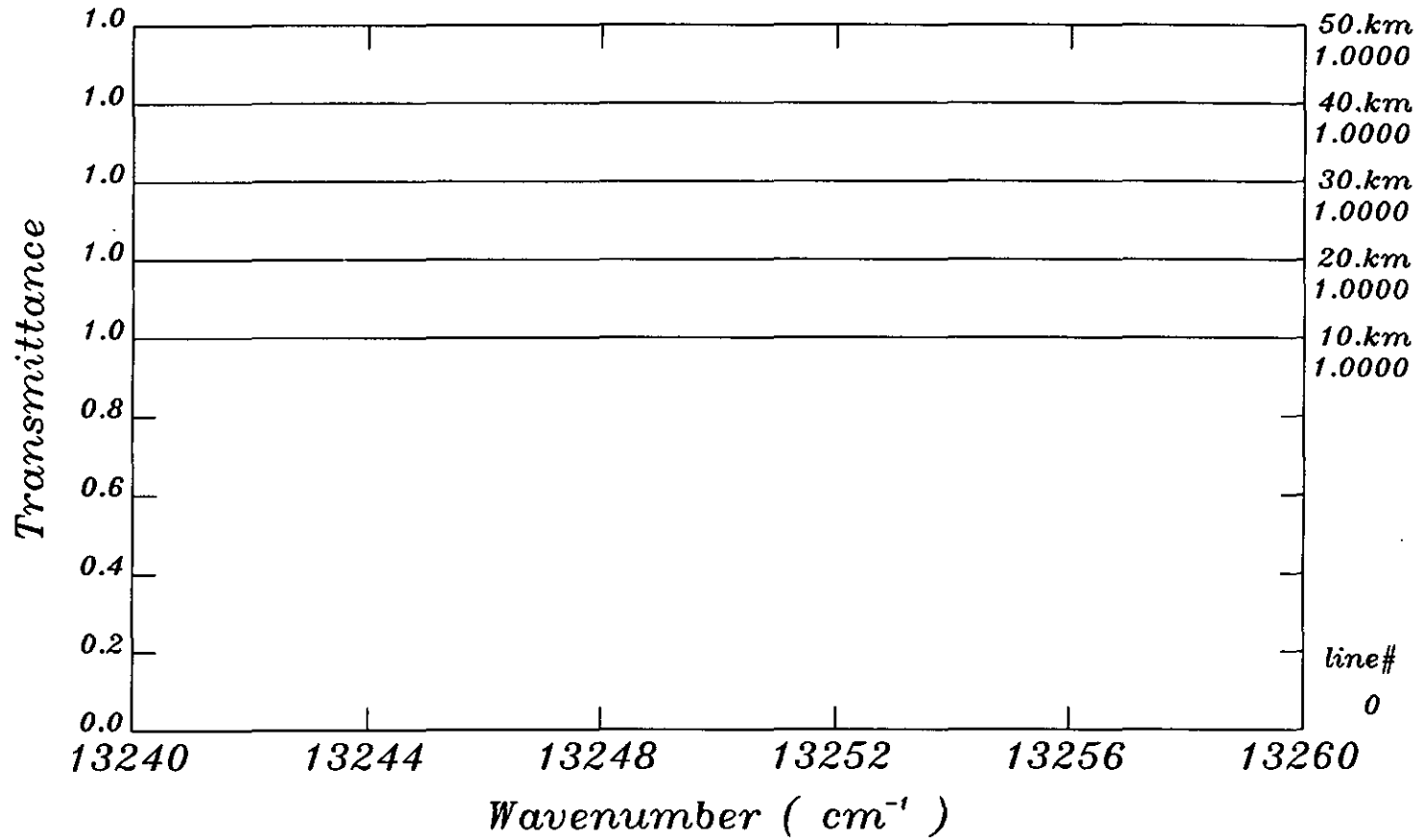

O2
50.km
0.9574
40.km
0.9362
30.km
0.8242
20.km
0.3487
10.km
0.0019
line#
49
Transmittance
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
13140
13144
13148
13152
13156
13160
Wavenumber (cm⁻¹)

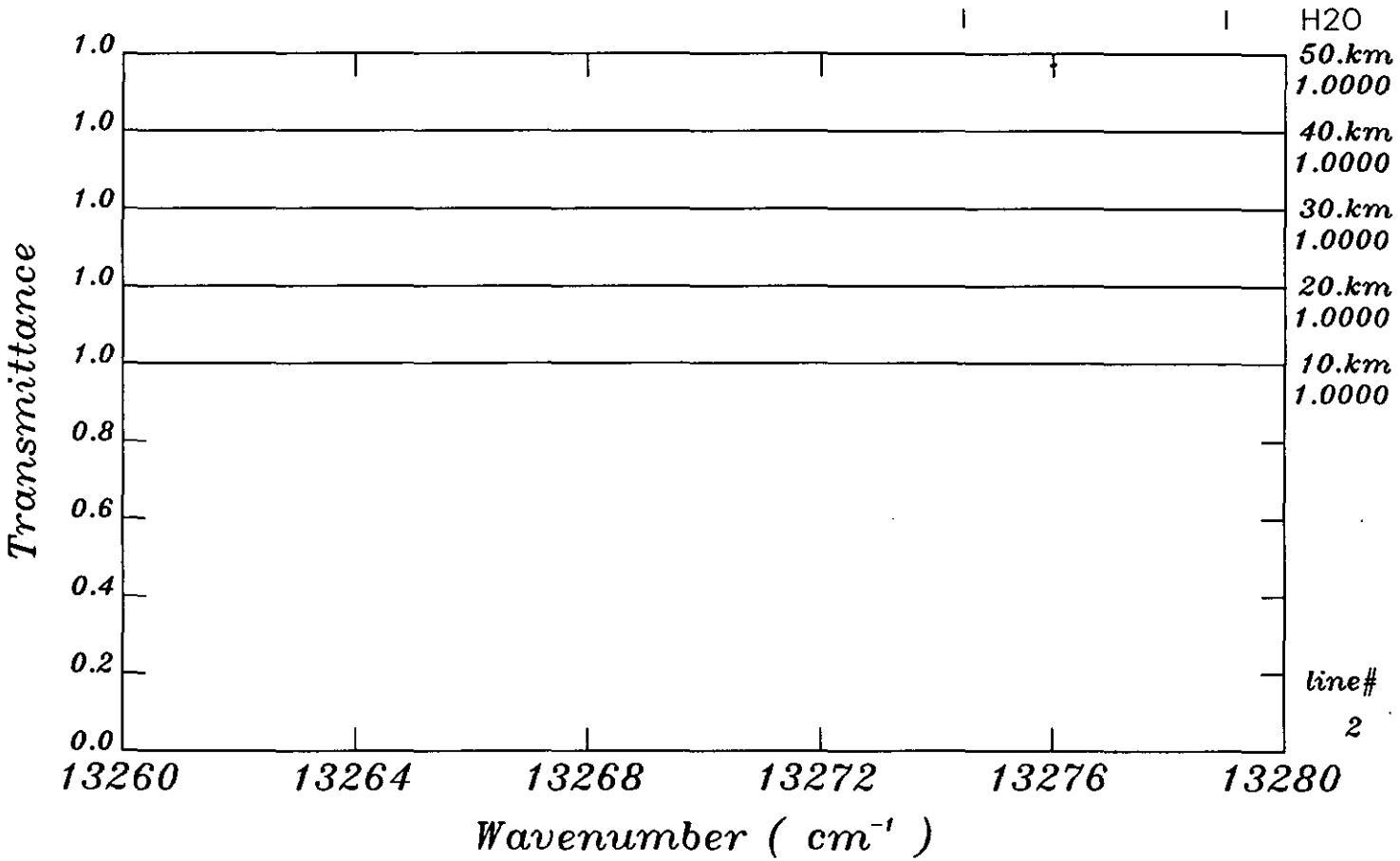

O2
50.km
0.9861
40.km
0.9756
30.km
0.9640
20.km
0.8924
10.km
0.7146
line#
48
Transmittance
1.0
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
13160
13164
13168
13172
13176
13180
Wavenumber (cm⁻¹)


1.0
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
Transmittance
50.km
1.0000
40.km
1.0000
30.km
1.0000
20.km
1.0000
10.km
1.0000
line#
0
13180
13184
13188
13192
13196
13200
Wavenumber (cm⁻¹)


1.0
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
Transmittance
50.km
1.0000
40.km
1.0000
30.km
1.0000
20.km
1.0000
10.km
1.0000
line#
0
13200
13204
13208
13212
13216
13220
Wavenumber (cm⁻¹)


1.0
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
Transmittance
50.km
1.0000
40.km
1.0000
30.km
1.0000
20.km
1.0000
10.km
1.0000
line#
0
13220
13224
13228
13232
13236
13240
Wavenumber (cm⁻¹)


1.0
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
Transmittance
50.km
1.0000
40.km
1.0000
30.km
1.0000
20.km
1.0000
10.km
1.0000
line#
0
13240
13244
13248
13252
13256
13260
Wavenumber (cm⁻¹)


H2O
50.km
1.0000
40.km
1.0000
30.km
1.0000
20.km
1.0000
10.km
1.0000
line#
2
1.0
1.0
1.0
1.0
1.0
0.8
0.6
0.4
0.2
0.0
Transmittance
13260
13264
13268
13272
13276
13280
Wavenumber (cm⁻¹)

[**Appendix A**] (Infrared calculation)

Charged Time for the Simulations on VAX 11/785 System
(except for the program compilation time)

Wavenumber (cm^{-1})	TRN.FOR;50			TRNS.FOR;51		
	Date	CPU Time	Elapsed Time	Date	CPU Time	Elapsed Time
0830 - 0850	8/08	1: 00' 51"	1: 57' 33"	-	-	-
0850 - 0900	5/21	11: 25' 35"	27: 46' 40"	5/22	23' 18.27"	1: 01' 47"
0900 - 0940	5/22	3: 39' 21"	11: 17' 03"	5/22	17' 09.33"	1: 09' 31"
0940 - 0980	5/22	1: 24' 44"	4: 54' 48"	5/22	20' 23.27"	39' 46"
0980 - 1020	5/23	3: 40' 06"	12: 30' 05"	5/23	19' 13.61"	1: 04' 56"
1020 - 1060	5/24	4: 38' 11"	13: 58' 49"	5/24	19' 30.58"	24' 45"
1060 - 1100	5/24	2: 22' 13"	9: 27' 21"	5/24	20' 46.02"	38' 23"
1100 - 1180	5/25	3: 33' 46"	10: 14' 00"	5/25	44' 23.49"	1: 18' 00"
1150 - 1250	5/16	3: 21' 20"	3: 49' 50"	5/16	56' 00.85"	1: 03' 24"
1250 - 1350	5/07	2: 59' 12"	6: 54' 24"	5/10	55' 43.97"	1: 12' 03"
1350 - 1450	5/08	2: 17' 44"	5: 15' 58"	5/11	54' 12.36"	1: 05' 57"
1450 - 1550	5/09	2: 14' 10"	5: 18' 13"	5/11	52' 55.71"	1: 49' 05"
1550 - 1650	5/15	4: 53' 46"	5: 50' 40"	5/16	54' 52.98"	1: 52' 13"

* TRN.FOR;50 is used for cross section calculation and its file output and plot data output of the total transmittances.

* TRNS.FOR;51 is used for each gas transmittance calculations at 20 km altitude with reading the cross section file.

[**Appendix B**] (Infrared re-calculation including CFC-11 and CFC-12)

Charged Time for the Simulations on VAX 11/785 System
(except for the program compilation time)

Wavenumber (cm^{-1})	TRNF.FOR;55			TRNFS.FOR;54		
	Date	CPU Time	Elapsed Time	Date	CPU Time	Elapsed Time
0830 - 0850	8/09	12' 33"	2: 10' 01"	8/09	11' 58.43"	34' 30"
0850 - 0860	7/30	7' 42"	29' 50"	7/30	6' 04.19"	20' 57"
0860 - 0900	8/07	39' 12"	48' 23"	8/07	24' 00.61"	34' 41"
0900 - 0940	8/08	31' 36"	39' 32"	8/08	20' 14.30"	55' 25"
1060 - 1070	8/08	9' 45"	13' 07"	8/08	5' 55.54"	7' 50"
1070 - 1100	8/09	33' 43"	1: 06' 58"	8/09	22' 33.15"	49' 59"
1100 - 1180	8/09	1: 19' 54"	2: 12' 47"	8/09	49' 14.96"	2: 49' 43"

* TRNF.FOR;55 is used for transmittance calculation with reading cross section files including CFC-11 & CFC-12, and plot data output of the total transmittances.

* TRNFS.FOR;54 is used for each gas transmittance calculations at 20 km altitude with reading the cross section file including CFC-11 & CFC-12.

[Appendix C] (Visible calculation)

Charged Time for the Simulations on VAX 11/785 System
(except for the program compilation time)

Temperature condition	TRNV.FOR;54		
	Date	CPU Time	Elapsed Time
Standard ($\Delta T = 0$)	7/03	43' 02"	57' 47"
$\Delta T = +10$	7/10	43' 04"	56' 44"
$\Delta T = -10$	7/10	42' 51"	1: 32' 54"

* TRNV.FOR;54 is used for cross section calculation and plot data output of the total transmittances.

* Temperatures in all atmospheric layers are shifted at the amount of ΔT. Pressure in each layer is automatically re-calculated from temperature by the hydrostatics relation in the program TRNV.FOR.