spheric Aerosols: Their Optical Properties and Effects, NASA CP-2004). The condition of validity of Eq. (10) is $n(r) \sim r^\epsilon$ for $\epsilon > 0$ and $r \to 0$. While the relative merits of the two solutions in Eqs. (9) and (10) should be determined from detailed numerical tests, our solution should be preferred since it is both simpler and more general. Thus, in opposition to Eq. (10), our solution, Eq. (9), does not require the prior determination of the aerosol number density N. Further, the above conditions of validity of Eq. (10) are more stringent than those attending our solution. Under these restrictive conditions, the two solutions are equivalent (Box and McKellar, preprint); nevertheless, only our solution is valid for more general conditions.

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Update of the AFGL atmospheric absorption line parameters compilation

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There is now available a new version of the AFGL atmospheric absorption line parameters compilation,[1] the compilation of spectroscopic data for the seven ir active gases significant in the terrestrial atmosphere: water vapor; carbon dioxide; ozone; nitrous oxide; carbon monoxide; and oxygen. This new version supersedes the last revision of September 1976.[2] The major modifications are to water vapor, carbon dioxide, methane, and oxygen (identified as molecules 1, 2, 6, and 7 on the compilation).

All halfwidths of **water** for transitions up to 13,000 cm^{-1} have been replaced with values obtained from theoretical calculations based on Ref. 3. The new linewidths differ substantially from the older values for high-J transitions. The calculations were also carried out separately for the four isotopes, although no vibrational dependence of width has been included. Previously the widths of the isotopic lines of $H_2^{18}O$ and $H_2^{17}O$ were to have been assumed equal to those of the equivalent transitions of $H_2^{16}O$. Nevertheless, many of the widths of the two less abundant isotopes were in error on earlier versions of the compilation apparently due to a program error; this situation is now rectified as well by the separate calculations.

The lower state energies of all the symmetric isotopes of water have been updated to be consistent with the recent work of Flaud *et al.*[4-7] Work is still in progress with the purpose of improving the transition frequencies and strengths of most of the water bands—thus it will be found that the present line positions do not in general form a self-consistent set with the latest energy levels.

Originally, the compilation was not expected to cover wavelengths shorter than 1 μm. However, first with the addition of the atmospheric oxygen bands, and now with the inclusion of high vibrational water transitions described below, the compilation extends to about 18,000 cm^{-1}. This has necessitated the continuation of the $3\nu + \delta$ region of water (0.8 μm) that was abruptly terminated in the early versions. The data[8] have been resumed at 12,075 cm^{-1} and extend to 12,938 cm^{-1}.

Some 2933 lines in the visible region ($4\nu, 4\nu + \delta, 5\nu$) from 13,274 cm^{-1} to 17880 cm^{-1} have been incorporated into the

Table I.   Visible Bands of $H_2^{16}O$ on Compilation ($4\nu, 4\nu + \delta, 5\nu$)

ν_0 obs cm^{-1}	ν'	ν''	No. of lines Type A	No. of lines Type B	Range cm^{-1}	J_{max}
13256?	141	000	41	0	13291–13828	9
13448?	042	000	0	8	13319–13941	8
13642?	320	000	0	16	13480–13939	8
13652.650	221	000	216	0	13311–14163	11
13828.3	202	000	0	169	13318–14142	12
13830.922	301	000	330	0	13274–14216	14
13910.8	122	000	0	38	13549–14138	7
14066.193	023	000	63	0	13932–14425	7
14221.143	400	000	0	173	13958–14647	10
14318.802	103	000	235	0	13926–14657	12
14536.87	004	000	0	64	14137–14776	7
14640?	151	000	2	0	14923–15220	8
15107?	330	000	0	2	15251–15414	4
15119.026	231	000	107	0	14908–15524	9
15344.499	212	000	0	110	15084–15667	9
15347.949	311	000	237	0	14946–15723	13
15742.787	410	000	0	35	15606–15939	6
15832.757	113	000	109	0	15584–15964	9
16821.626	321	000	143	0	16466–17191	11
16825.23	222	000	0	48	16624–17108	8
16898.4?	302	000	0	134	16487–17091	12
16898.828	401	000	227	0	16487–17228	12
17227.7	420	000	0	10	17129–17281	4
17312.54	123	000	77	0	17126–17628	7
17458.203	500	000	0	108	17145–17715	9
17495.517	203	000	182	0	17143–17787	11
17748.073	104	000	0	49	17474–17880	6

Energy level V	G cm^{-1}	B cm^{-1}	D $\times 10^{-7}$ cm^{-1}
10012	3612.840	0.38750493	1.5815[a]
10011	3714.781	0.38706227	1.1357[b]
11112c	4247.707	0.38777786	1.4551
11112d		0.38820392	1.5510
11111c	4390.629	0.38736682	1.2832
11111d		0.38823393	1.1913
20013	4853.629	0.38818956	1.7725
12212c	4887.982	0.3889637	1.3507
12212d			1.4743
20012	4977.840	0.38652459	1.3059
12211c	5061.773	0.3885416	1.3917
12211d			1.2588
20011	5099.663	0.38749344	0.9330
21113d	5475.076	0.3894248	1.6916
21111c	5790.584	0.3874127	1.1469
21111d		0.3886293	1.0486
10022	5915.220	0.3845244	1.5597
10021	6016.687	0.3839705	1.4037

[a] $H = 2.74 \times 10^{-13}$ cm^{-1}.
[b] $H = 1.10 \times 10^{-13}$ cm^{-1}.

compilation from the measurements of J.W. Brault at Kitt Peak National Observatory. The experimental procedure and analysis are discussed in Ref. 9. A summary of the new bands is given in Table I. The experimentally measured halfwidths were used for these bands. In cases where lines are blended, an asterisk has been placed in the quantum identification field of the compilation directly after the lower vibrational state, $v'' = 000$ (column 70 in the card image of a line).

It has previously been noted[10,11] that discrepancies and errors existed in some of the 531 bands of **carbon dioxide** on the compilation. Most of these bands have been recalculated based on the updated molecular constants of Ref. 10. Hot cell Fourier transform spectrometer measurements of Sakai[12] of the principal isotope provided revised constants, which are given in Table II. The energy level notation is $v_1 v_2 l v_3 r$, with r designating the position of the level in the Fermi resonating group of levels. When $l = 2$, $B_c = B_d$. The levels of Table II affected changes in other levels that share allowed transitions, and thus the tables in Ref. 10 should be modified to reflect this interdependence.

The two major bands of **methane**, ν_3 at 3.3 μm and ν_4 at 7.7 μm, have been improved. For the former band the experimental data of Sakai[13] have been incorporated. However, some lines were unidentified; thus there will be some transitions without a lower state energy given. This situation will be remedied by further analysis of this band. The 7.7-μm band of methane has been replaced with the values given in Ref. 14. This revision has eliminated the intensity error that existed in the earlier version of the compilation.

The (2-0) γ-band of the $b^1\Sigma_g - X^3\Sigma_g^-$ system of **oxygen** at 6280 Å has been added.[15] In addition, the (1-1) atmospheric A-band has been placed on the compilation. Refined vibrational constants have been used on the atmospheric bands, and additional weak isotopic lines that were observed in the solar spectrum measurements[9] have been included.

The compilation is available for a service charge of $60.00 in the form of a seven- or nine-track magnetic tape from the National Climatic Center of NOAA, Environmental Data Service, Federal Building, Asheville, North Carolina 28801, attention of Brian Wallace. The new version now possesses a file marker every 100 cm^{-1}. Note that this may cause a succession of file markers (empty files) in window regions, such as between 16,000 cm^{-1} and 16,400 cm^{-1}. There is also now included on the tape information in the first file (at zero frequency) in the quantum identification field intended to provide users with a description of the format of the compilation and the date of the version of the atlas they possess. Finally, several errors in quantum assignments of water lines were discovered since the last revision, and these have been corrected. The atlas now contains over 139,000 transitions covering the 0.3–17,880-cm^{-1} range.

Numerous researchers have contributed to the improvements of the compilation. Foremost among the contributions have been the analyses of W. S. Benedict. Thanks are due to S. A. Clough and F. X. Kneizys of AFGL and F. Winther of the University of Kiel who have brought attention to errors that existed on the compilation. We also thank D. Kitrosser of Lowell University and J. Chetwynd of AFGL for their assistance in the transcription of data.

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Optical characteristics of a clear epoxy

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In a recent project in broadband light interferometry at our laboratory, it was necessary to consider the use of ce-