Atlas of Infrared Absorption Lines

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CONTRACT NSG-1203
NOVEMBER 1977
Atlas of Infrared Absorption Lines

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Prepared for
Langley Research Center
under Contract NSG-1203

NASA
National Aeronautics
and Space Administration
Scientific and Technical
Information Office
1977
This is a revised edition of the Atlas of Infrared Absorption Lines, NASA CR-144976. Three absorption bands, HNO$_3$ ($2\nu_9$) and CH$_3$Cl ($\nu_4$ and $3\nu_6$) are added in this edition. Infrared absorption line strength (atm$^{-1}$ cm$^{-2}$) vs. line position (cm$^{-1}$) at 300 K for 15 gases are shown in Fig. 1-65 from 500 cm$^{-1}$ to 7,000 cm$^{-1}$. The absorption bands for each gas shown in the atlas including sources of data are summarized in Table I.

This atlas was found to be useful for feasibility studies of remote sensing of atmospheric pollutants and for the identification of gases in atmospheric absorption spectra. The author hopes that this atlas will provide for those working in the field of infrared spectroscopy a quick guide to obtaining information on (1) what gases contribute to energy absorption in spectral regions of interest and (2) their relative strengths in absorption. Special attention should be given to the scale of line strength. The lines are grouped into intervals of 100 cm$^{-1}$ and only those lines with a strength within $10^{-5}$ of the maximum value are shown in each interval. Therefore, sudden changes appear in the scales from one interval to another. More absorption line parameters will be added as they become available, and an updated atlas will be released upon request in the future.
Table I. Band centers and sources of data shown in the atlas.

<table>
<thead>
<tr>
<th>Gas</th>
<th>Band</th>
<th>(cm⁻¹)</th>
<th>(ν)</th>
<th>Source of Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>H₂O</td>
<td>ν₂</td>
<td>(1595)</td>
<td>(6.27)</td>
<td>McClatchey et al. (1973)</td>
</tr>
<tr>
<td></td>
<td>ν₁</td>
<td>(3657)</td>
<td>(2.73)</td>
<td>McClatchey et al. (1973)</td>
</tr>
<tr>
<td></td>
<td>ν₃</td>
<td>(3756)</td>
<td>(2.66)</td>
<td>McClatchey et al. (1973)</td>
</tr>
<tr>
<td>CO₂</td>
<td>ν₂</td>
<td>(677)</td>
<td>(15.0)</td>
<td>McClatchey et al. (1973)</td>
</tr>
<tr>
<td></td>
<td>ν₃</td>
<td>(2349)</td>
<td>(4.26)</td>
<td>McClatchey et al. (1973)</td>
</tr>
<tr>
<td>O₃</td>
<td>ν₂</td>
<td>(701)</td>
<td>(14.3)</td>
<td>McClatchey et al. (1973)</td>
</tr>
<tr>
<td></td>
<td>ν₃</td>
<td>(1042)</td>
<td>(9.60)</td>
<td>McClatchey et al. (1973)</td>
</tr>
<tr>
<td></td>
<td>ν₁</td>
<td>(1103)</td>
<td>(9.07)</td>
<td>McClatchey et al. (1973)</td>
</tr>
<tr>
<td>N₂O</td>
<td>ν₂</td>
<td>(589)</td>
<td>(17.0)</td>
<td>McClatchey et al. (1973)</td>
</tr>
<tr>
<td></td>
<td>ν₁</td>
<td>(1285)</td>
<td>(7.78)</td>
<td>McClatchey et al. (1973)</td>
</tr>
<tr>
<td></td>
<td>ν₃</td>
<td>(2224)</td>
<td>(4.50)</td>
<td>McClatchey et al. (1973)</td>
</tr>
<tr>
<td>CO</td>
<td>1-0</td>
<td>(2145)</td>
<td>(4.66)</td>
<td>McClatchey et al. (1973)</td>
</tr>
<tr>
<td></td>
<td>2-0</td>
<td>(4260)</td>
<td>(2.35)</td>
<td>McClatchey et al. (1973)</td>
</tr>
<tr>
<td></td>
<td>3-0</td>
<td>(6350)</td>
<td>(1.57)</td>
<td>McClatchey et al. (1973)</td>
</tr>
<tr>
<td>CH₄</td>
<td>ν₄</td>
<td>(1306)</td>
<td>(7.66)</td>
<td>McClatchey et al. (1973)</td>
</tr>
<tr>
<td></td>
<td>ν₂</td>
<td>(1534)</td>
<td>(6.52)</td>
<td>McClatchey et al. (1973)</td>
</tr>
<tr>
<td></td>
<td>ν₃</td>
<td>(3019)</td>
<td>(3.31)</td>
<td>McClatchey et al. (1973)</td>
</tr>
<tr>
<td>O₂</td>
<td>0-1</td>
<td>(6325)</td>
<td>(1.58)</td>
<td>McClatchey et al. (1973)</td>
</tr>
<tr>
<td></td>
<td>(1Δ-3Σ)</td>
<td></td>
<td></td>
<td>Calfee (1973, unpublished)</td>
</tr>
<tr>
<td></td>
<td>ν₁</td>
<td>(1151)</td>
<td>(8.69)</td>
<td>Calfee (1973, unpublished)</td>
</tr>
<tr>
<td></td>
<td>ν₃</td>
<td>(1362)</td>
<td>(7.34)</td>
<td>Calfee (1973, unpublished)</td>
</tr>
<tr>
<td>NO</td>
<td>1-0</td>
<td>(1876)</td>
<td>(5.33)</td>
<td>Abels and Shaw (1966)</td>
</tr>
<tr>
<td>NO₂</td>
<td>ν₃</td>
<td>(1621)</td>
<td>(6.17)</td>
<td>Goldman et al. (1975)</td>
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<tr>
<td></td>
<td>ν₁+ν₃</td>
<td>(2910)</td>
<td>(3.44)</td>
<td>Goldman (1975, private)</td>
</tr>
<tr>
<td>NH₃</td>
<td>ν₂</td>
<td>(933)</td>
<td>(10.70)</td>
<td>Taylor (1973)</td>
</tr>
<tr>
<td>HCl</td>
<td>1-0</td>
<td>(2886)</td>
<td>(3.46)</td>
<td>Benedict et al. (1956) and Toth et al. (1970)</td>
</tr>
<tr>
<td></td>
<td>2-0</td>
<td>(5668)</td>
<td>(1.76)</td>
<td></td>
</tr>
<tr>
<td>HF</td>
<td>1-0</td>
<td>(3962)</td>
<td>(2.52)</td>
<td>Goldman et al. (1974)</td>
</tr>
<tr>
<td>HNO₃</td>
<td>2ν₉</td>
<td>(896)</td>
<td>(11.16)</td>
<td>Brockman (1977, private)</td>
</tr>
<tr>
<td>CH₃Cl</td>
<td>ν₄</td>
<td>(3039)</td>
<td>(3.29)</td>
<td>Margolis (1977, private)</td>
</tr>
<tr>
<td></td>
<td>3ν₆</td>
<td>(3042)</td>
<td>(3.29)</td>
<td>Margolis (1977, private)</td>
</tr>
</tbody>
</table>

NOTE: The combination bands taken from McClatchey et al. (1973) are not listed in this table although the data are plotted.
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6. Taylor, F. M. (1973)
   Spectral data for the \( \nu_2 \) band of ammonia with application to radiative

   Line strengths, line widths, and dipole moment function for HCl.
FIG. 1. LINE STRENGTH VS. WAVENUMBER (500 AND 600 CM$^{-1}$, 20.00-16.66 MICRON)
FIG. 2. LINE STRENGTH VS. WAVENUMBER (600 AND 700 CM\(^{-1}\), 16.66-14.28 MICRON)
FIG. 3. LINE STRENGTH VS. WAVENUMBER (700 AND 800 CM⁻¹, 14.28-12.50 MICRON)
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WAVENUMBER

LOG (LINE STRENGTH, ATM-1 CM⁻²)
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LOG (LINE STRENGTH, ATM-1 CM-2)

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FIG. 45. LINE STRENGTH VS. WAVENUMBER (4900 AND 5000 CM\(^{-1}\), 2.04 - 2.00 MICRON)
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FIG. 47. LINE STRENGTH VS. WAVENUMBER (5100 AND 5200 CM$^{-1}$, 1.98 - 1.92 MICRON)
FIG. 48. LINE STRENGTH VS. WAVENUMBER (5200 AND 5300 CM$^{-1}$, 1.32 - 1.88 MICRON)
FIG. 49. LINE STRENGTH VS. WAVENUMBER (5300 AND 5400 CM$^{-1}$, 1.88 - 1.85 MICRON)
FIG. 50. LINE STRENGTH VS. WAVENUMBER (5400 AND 5500 CM⁻¹, 1.85 - 1.81 MICRON)
FIG. 51. LINE STRENGTH VS. WAVENUMBER (5500 AND 5600 CM⁻¹, 1.81 - 1.78 MICRON)
FIG. 52. LINE STRENGTH VS. WAVENUMBER (5600 AND 5700 CM$^{-1}$, 1.78 - 1.75 MICRON)
FIG. 53. LINE STRENGTH VS. WAVENUMBER (5700 AND 5800 CM⁻¹, 1.75 - 1.72 MICRON)
FIG. 54. LINE STRENGTH VS. WAVENUMBER (5800 AND 5900 CM$^{-1}$, 1.72 - 1.69 MICRON)
FIG. 55. LINE STRENGTH VS. WAVENUMBER (5900 AND 6000 CM⁻¹, 1.69 - 1.66 MICRON)
FIG. 56. LINE STRENGTH VS. WAVENUMBER (6000 AND 6100 CM\(^{-1}\), 1.66 - 1.63 MICRON)
FIG. 57. LINE STRENGTH VS. WAVENUMBER (6100 AND 6200 CM$^{-1}$, 1.63 - 1.61 MICRON)
FIG. 5B. LINE STRENGTH VS. WAVENUMBER (6200 AND 6300 CM⁻¹, 1.61 - 1.58 MICRON)
**FIG. 59. LINE STRENGTH VS. WAVENUMBER (6300 AND 6400 CM$^{-1}$, 1.58 - 1.56 MICRON)**
FIG. 60. LINE STRENGTH VS. WAVENUMBER (6400 AND 6500 CM⁻¹, 1.56 - 1.53 MICRON)
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Fig. 62. Line strength vs. wavenumber (6600 and 6700 cm⁻¹, 1.51 - 1.49 micron)
FIG. 63. LINE STRENGTH VS. WAVE NUMBER ( 6700 AND 6800 CM⁻¹, 1.49 - 1.47 MICRON )
FIG. 64. LINE STRENGTH VS. WAVENUMBER (6800 AND 6900 CM⁻¹, 1.47 - 1.44 MICRON)
FIG. 65. LINE STRENGTH VS. WAVENUMBER (6900 AND 7000 CM$^{-1}$, 1.44 - 1.42 MICRON)
This report supercedes NASA CR-144976.

NASA CR-2925

2. Government Accession No.  

3. Recipient's Catalog No.  

4. Title and Subtitle  
Atlas of Infrared Absorption Lines

5. Report Date  
November 1977

6. Performing Organization Code  

7. Author(s)  
Jae H. Park


9. Performing Organization Name and Address  
College of William and Mary
Williamsburg, Virginia 23185

10. Work Unit No.  

11. Contract or Grant No.  
NSG 1203

12. Sponsoring Agency Name and Address  
National Aeronautics and Space Administration
Washington, D.C. 20546

13. Type of Report and Period Covered  
Contractor Report

15. Supplementary Notes  
This report supercedes NASA CR-144976.

16. Abstract  
This atlas of infrared absorption lines contains absorption line parameters (line strength vs. wavenumber) from 500 to 7000 cm⁻¹ for 15 gases: H₂O, CO₂, O₃, N₂O, CO, CH₄, O₂, SO₂, NO, NO₂, NH₃, HCl, HF, HNO₃ and CH₂Cl₂.

17. Key Words (Suggested by Author(s))  
Spectroscopy, Infrared, Absorption, Emission, Remote Sensing, Pollution

18. Distribution Statement  
Unclassified - Unlimited

19. Security Classif. (of this report)  
Unclassified

20. Security Classif. (of this page)  
Unclassified

21. No. of Pages  
68

22. Price*  
$4.50

*For sale by the National Technical Information Service, Springfield, Virginia 22161.