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Atlas of Infrared Absorption Lines

Jae H. Park

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Atlas of Infrared Absorption Lines

Jae H. Park
The College of William and Mary
Williamsburg, Virginia

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This is a revised edition of the Atlas of Infrared Absorption Lines, NASA CR-144976. Three absorption bands, HNO$_3$ ($2v_9$), and CH$_3$Cl ($v_4$ and $3v_6$) 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 (¹Δ-³Σ)</td>
<td>(6325)</td>
<td>1.58</td>
<td>McClatchey et al. (1973)</td>
</tr>
<tr>
<td>SO₂</td>
<td>ν₂</td>
<td>(518)</td>
<td>19.30</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>
</tr>
<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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   Line strengths, line widths, and dipole moment function for HCl.
FIG. 1. LINE STRENGTH VS. WAVENUMBER (500-600 CM⁻¹, 20.00-16.66 MICRON)
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LOG (LINE STRENGTH, ATM-1 CM-2)

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

WAVE NUMBER

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FIG. 52. LINE STRENGTH VS. WAVENUMBER (5600 AND 5700 CM⁻¹, 1.78 - 1.75 MICRON)
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FIG. 54. LINE STRENGTH VS. WAVE NUMBER (5800 AND 5900 CM$^{-1}$, 1.72 - 1.69 MICRON)
FIG. 55. LINE STRENGTH VS. WAVENUMBER (5900 AND 6000 CM^{-1}, 1.65 - 1.66 MICRON)
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FIG. 63. LINE STRENGTH VS. WAVENUMBER (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)
**Title and Subtitle**

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**Author(s)**

Jae H. Park

**Performing Organization Name and Address**

College of William and Mary
Williamsburg, Virginia 23185

**Sponsoring Agency Name and Address**

National Aeronautics and Space Administration
Washington, D.C. 20546

**Abstract**

This atlas of infrared absorption lines contains absorption line parameters (line strength vs. wavenumber) from 500 to 7000 cm\(^{-1}\) for 15 gases: H\(_2\)O, CO\(_2\), O\(_3\), N\(_2\)O, CO, CH\(_4\), O\(_2\), SO\(_2\), NO, NO\(_2\), NH\(_3\), HCl, HF, HNO\(_3\) and CH\(_3\)Cl.

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- Remote Sensing
- Pollution

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