Infrared laboratory spectroscopy and satellite remote sensing measurements

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Optical measurements of atmospheric minor constituents are carried out using spectrometers working in the UV-visible, infrared and microwave spectral ranges. In all cases the quality of the analysis and of the interpretation of the atmospheric spectra requires the best possible knowledge of the molecular parameters of the species of interest. To illustrate this point we will concentrate on recent laboratory studies of nitric acid, ethane and formaldehyde. On the other hand there are a few cases where the spectroscopic properties of a molecule can be improved by using atmospheric spectra. As an example, recent NO^+ results derived from the MIPAS (Michelson Interferometer for Passive Atmospheric Sounding) experiment will be presented.
Nitric acid is one of the important minor constituent of the terrestrial atmosphere. Using new and accurate experimental results concerning the spectroscopic properties of the $H^{14}NO_3$ and $H^{15}NO_3$ molecules, as well as improved theoretical methods, it has been possible to generate an improved set of line parameters for these molecules in the 11.2 μm spectral region. These line parameters were used to detect for the first time the $H^{15}NO_3$ molecule in the atmosphere analyzing atmospheric spectra recorded by the MIPAS experiment.
The 12 μm region of ethane is commonly used to determine ethane's abundance in the atmospheres. Precise and accurate absolute intensities of this band are then crucial for a correct interpretation of recent Cassini observations of ethane spectra in the atmospheres of Saturn and Titan. Using recent experimental results and performing a global analysis of data, we have generated a new set of line parameters which provides a much more accurate description of the experimental spectrum of C_2H_6 in this region than the previous results provided by the 2004 versions of the HITRAN and GEISA databases.
For the measurement of atmospheric formaldehyde concentrations, mid-infrared and ultraviolet absorptions are both used by ground, air or satellite instruments. It is then of the utmost importance to have consistent spectral parameters in these various spectral domains. Consequently the aim of the study performed at LISA was to intercalibrate formaldehyde spectra in the infrared and ultraviolet regions acquiring simultaneously UV and IR spectra using a common optical cell. The results of the work will be presented. Also the infrared data have been used to derive vertical distributions from the upper troposphere to the stratopause using the high spectral resolution measurements of MIPAS

Using MIPAS measured spectra of the Earth's upper atmosphere in the 4.3 m region with the highest spectral resolution ever reached in this altitude region we were able to get the line positions of the 1←0 and 2←1 ro-vibrational NO^+ transitions with an unprecedented accuracy allowing one to determine a new set of Hamiltonian constants producing a much improved prediction of the line positions of this species.