INFRARED SPECTROSCOPY AND THE ATMOSPHERE

JEAN-MARIE FLAUD, *Laboratoire de Photophysique Moléculaire, C.N.R.S., Bât. 350, Université Paris-Sud, 91405 Orsay Cedex, France*.

Nowadays in spite of numerous efforts the behavior and the evolution of the terrestrial atmosphere are far from being satisfactorily understood. This is particularly true for the troposphere where overarching issues such as air quality, free tropospheric ozone level, natural versus anthropogenic emissions, chemistry-climate feedbacks, ... are still open. These questions are tackled both from the theoretical point of view by developping chemical transport models and from the experimental point of view using various platforms (Ground, airborne, satellites). However measurements from space are the only ones able to provide a continental or global view of the atmosphere. In the next few years optical remote sensing intruments working in the infrared such as MIPAS, TES, ... will be in operation. These instruments cover wide spectral ranges at high spectral resolutions with excellent signal to noise ratios. Obviously the analysis of the corresponding atmospheric spectra and the accuracy of the retrieved profiles depends highly on the quality of the spectral parameters. Given the improved capabilities of the new instruments, it is clear that new laboratory studies using the best experimental techniques and/or sophisticated theoretical models are required. In many cases one has to face the "classical" problem of laboratory work, i.e. reaching the required accuracy and determining it properly. This is an extremely difficult problem in itself but, in a number of cases, one has to tackle even more challenging questions. Let us quote in particular the difficulty of measuring accurate line intensities for unstable molecules or of modeling the spectrum of heavy species or accounting for realistic line shapes. During this lecture, after a short presentation of the atmospheric photochemistry and of a remote sensing satellite experiment, the talk will concentrate on real examples linked to the "challenging spectroscopic questions" quoted above. The case of the HOCl molecule for which simultaneous measurements in two different spectral regions were required to derive realistic intensities will be discussed first. For heavy species, the absorption of which appears as a quasi-continuum in the atmospheric spectra, there are two "schools of thought": either to measure all desired absorption cross sections for the whole range of atmospheric pressures and temperatures or to make some effort to model and generate a synthetic vibration-rotation spectrum. As an example the case of the $ClONO_2$ molecule will be described. Finally the problem of realistic line shapes is essential in atmospheric physics since it has to be accounted for if one wants to derive from the atmospheric spectra accurate temperature profiles (CO_2) or concentration profiles (CH_4).