Spectroscopy and atmospheric retrievals

J.-M. Flaud

LISA, University Paris 12&7 and CNRS, 61 Av. Général de Gaulle, 94010, Créteil,
France(flaud@lisa.univ-paris12.fr / Fax: 33 145171564 / Phone :33145171550)

Optical measurements of atmospheric minor constituents are performed using spectrometers working in the UV-visible, infrared and microwave spectral ranges. In particular recently the satellite ENVISAT has been launched with three spectrometers on board, SCIAMACHY and GOMOS working in the UV-visible spectral region and MIPAS working in the thermal infrared.

The analysis and interpretation of the atmospheric spectra require good knowledge of the molecular parameters of the species of interest as well as of the interfering species. This is true not only in the spectral domain used to retrieve the species (Thermal infrared for MIPAS for example) but also in the other spectral domains used by other instruments: Meaningful comparisons of profiles retrieved by various instruments using different spectral domains require indeed that the spectral parameters are consistent in these spectral domains. To illustrate these points we will concentrate on two molecules namely nitric acid and ozone.

For HNO_3 we will show the difficulty to measure line intensities in the laboratory and we will describe how a comparison of MIPAS profiles with those obtained by another instrument operating in a different spectral range(Far infrared) may be used to validate the HNO3 line parameters in the mid-infrared.

In the mid-infrared range, the 10 μm ozone band is very strong and is the most widely used to derive concentration profiles. In the UV region, the Huggins bands are currently used for spectroscopic remote-sensing of ozone.

In this talk we will present two sets of results:

First a careful comparison of four sets of ozone line intensities measured independently in the 10 μm region has been achieved. From them new and more accurate

transition moment constants for the ν_1 and ν_3 bands of $^{16}O_3$ were derived and used to generate new line positions and intensities. These new spectroscopic parameters allowed one to simulate atmospheric spectra better than the existing HITRAN spectroscopic parameters showing that on a relative basis the new spectral parameters are of better quality.

Second, even if there have been several intercomparisons of ozone absorption cross-sections in the UV and mid-infrared regions, these studies have been performed using the absorption of ozone at 254 nm. On the other hand, to our knowledge, no experimental study has verified the consistency between the cross-sections in the Huggins region and in the mid-infrared preventing meaningful comparisons of ozone concentration profiles obtained by spectrometric measurements in the two spectral regions. Therefore, the aim of this study has been to intercompare the ozone absorption cross-sections in the 10 μm and the 300-350 nm regions in order to verify their consistency and check if the published spectroscopic data in the two spectral regions are in agreement. Such a comparison has been performed by acquiring simultaneously UV and infrared spectra at room temperature and atmospheric pressure using a common optical cell.