LINE-MIXING AND COLLISION INDUCED ABSORPTION BY OXYGEN IN THE A BAND. LABORATORY MEASUREMENTS, MODEL, AND TOOLS FOR ATMOSPHERIC SPECTRA COMPUTATIONS

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The absorption by oxygen in the region of the O_2 A-band near 760 nm has been measured in the laboratory under various conditions of pressure (20-200 atm) and temperature (200-300 K) for both pure O_2 and O_2-N_2 mixtures. In order to calculate the contribution of the allowed A-band transitions, Lorentzian profiles and a model accounting for line-mixing (LM) effects using the Energy Corrected Sudden (ECS) approximation have been used. The differences between computed spectra and measured values enable extraction of the collision induced absorption (CIA) contribution. It is shown that neglecting line-mixing overestimates absorption in the wings and underestimates absorption at the P and R branch peaks, whereas the CIA extracted by the line-mixing approach shows the smooth profile expected. Applying this approach to our spectra enables determination of the CIA and allowed contributions for both O_2-O_2 and O_2-N_2 collisions versus temperature and pressure. The resulting model and data are then used to build a database and some software suitable for the calculation of oxygen (in air) atmospheric absorption and for easy inclusion in radiative transfer code. These tools are then applied to a theoritical study of the influences of both line-mixing and collision induced processes on atmospheric photon path escape factors and on cloud-top altitude retrievals. It is shown LM and CIA make significant contribution and explain a large part of the discrepancies between measured and calculated atmospheric absorption observed recently.