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Collision induced absorption and line-mixing effects in the O_2 A-band

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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 codes (available upon request). These tools are then applied to a theoretical 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 contributions and explain a large part of the discrepancies between measured and calculated atmospheric absorption observed recently.