COLLISIONAL NARROWING EFFECT ON ATMOSPHERIC TRANSMITTANCE

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ABSTRACT

Long-path high-resolution spectroscopic investigations in the open atmosphere are now feasible because of the recent development of extremely narrow-band, relatively high-power laser sources. The spectral dependence of the atmospheric transmittance will then be significant in the analysis of such experiments. Specifically, in the vicinity of a molecular absorption line in the atmosphere, small contributions to the line shape function may produce significant changes in the atmospheric transmittance over long optical paths in the open atmosphere. We here discuss the effect of collisional narrowing on the line shape function. It is the different temperature and pressure dependence of the collision narrowed and collision broadened contributions to the total line shape that results in a change in the atmospheric transmittance when the effect of collisional narrowing is included. The use of the Voight profile is discussed; it is shown that, over a wide range of wavelengths in the visible and near infrared regions of the spectrum, this function is not suitable to describe molecular absorption lines in the troposphere. The effect of collisional narrowing on atmospheric transmittance is found to be a sensitive function of several absorption line parameters, notably the absorption frequency and the line strength. Calculations are presented that illustrate the magnitude of the collisional narrowing effect for selected transmission paths and molecular absorption lines.