The Very Short-lived Ozone Depleting Substance, $CHBr_3$ (bromoform): Revised UV Absorption Spectrum, Atmospheric Lifetime and Ozone Depletion Potential

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Bromoform ($CHBr_3$) is a short-lived atmospheric trace gas primarily of natural origin that represents a source of reactive bromine in the troposphere as well as the stratosphere. The transport of short-lived brominated species to the stratosphere is known to be particularly impactful to stratospheric ozone. Evaluating the impact of $CHBr_3$ on stratospheric ozone requires a thorough understanding of its atmospheric loss processes, for which the dominant one is thought to be UV photolysis. Therefore, accurate $CHBr_3$ UV absorption cross section data for the atmospherically relevant wavelengths (λ) and temperatures are needed to calculate its photolysis loss rate.

In this study, UV absorption cross sections, $\sigma(\lambda,T)$, for $CHBr_3$ were measured at wavelengths between 300 and 345 nm and at temperatures between 260 and 330 K using cavity ring-down spectroscopy. A thorough investigation of possible sources of systematic error in the measurements is presented. The present UV absorption cross sections at longer wavelength (>310 nm) are systematically lower compared to currently recommended values for use in atmospheric models, with the deviation being more pronounced as wavelength increases and temperature decreases. A parameterization of the $CHBr_3$ UV spectrum for use in atmospheric models is developed and illustrative photolysis rate calculations are presented to highlight the impact of the revised $\sigma(\lambda,T)$ values on its calculated local lifetimes. For instance, $CHBr_3$ atmospheric photolysis rate in the tropical region obtained with the present spectral data was found to be 10-15% lower (longer lifetime) than that obtained using the currently recommended values. Moreover, seasonally dependent ozone depletion potentials (ODPs) for $CHBr_3$ emitted in the Indian sub-continent were calculated using the semi-empirical relationship of Brioude et al. (Brioude et al., *Geophys. Res. Lett.*, 37, L19804, doi: 10.1029/2010GL044856, 2010). In conclusion, the improved UV absorption cross section data for the short-lived ozone depleting substance $CHBr_3$, reported in this work, combined with OH kinetic data enables more accurate model predictions of stratospheric bromine loading and its impact on stratospheric ozone.

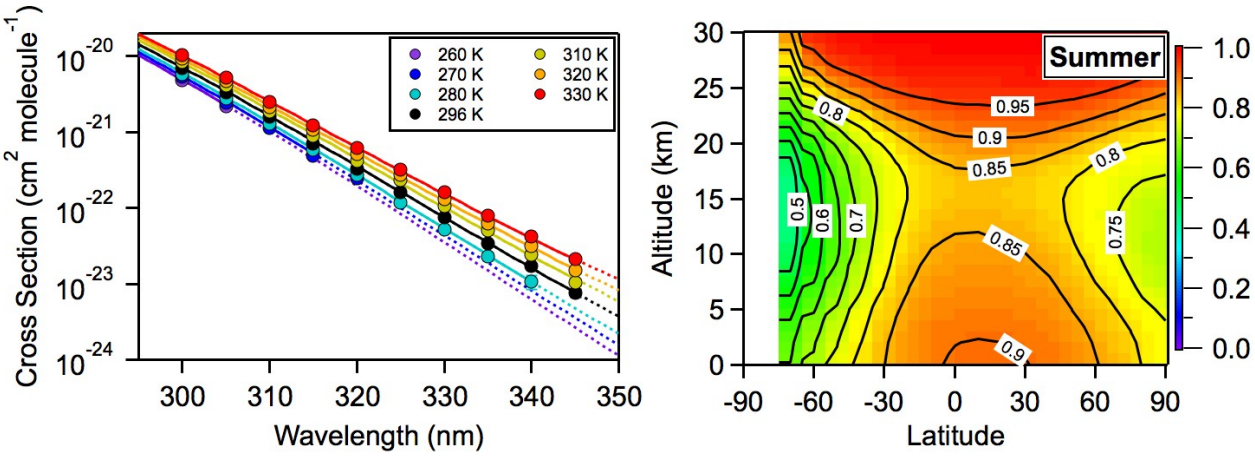

Figure 1. Left panel: $CHBr_3$ UV absorption cross sections (experimental data points and parameterization) for temperatures between 260 and 330K obtained in this work. Right panel: Ratio of the calculated $CHBr_3$ photolysis rates, for summer, obtained using the $CHBr_3$ UV spectrum parameterization, from this work, and those from the currently recommended UV absorption cross section values for use in atmospheric models.