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The impact of isotopic variations in optical measurements of atmospheric trace gas concentrations

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Laser and FTIR spectroscopic techniques have become increasingly common for high accuracy atmospheric trace gas analysis. In most cases spectroscopic techniques are isotopologue-specific. If a measurement of the most abundant isotopologue of a trace gas is used as a proxy for its total concentration, errors may arise if the isotopic composition of the target gas differs between the calibration gases and the samples measured and the differences are not correctly accounted for. Recent papers (1-3) have treated this isotopic sensitivity for CO_2 – in this paper the treatment is generalised and extended to other atmospheric trace gases such as CH4 and N2O. The potential errors, while generally small, are comparable to or greater than the inherent measurement precision of current spectroscopic techniques and to compatibility requirements for atmospheric greenhouse gas measurements recommended by the WMO-Global Atmosphere Watch. For the most accurate measurements in atmospheric trace gas analysis and metrology, the effects of isotopic variability should be at least assessed and preferably included in the analysis.

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