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波長スキャンキャビティーリングダウン分光分析計を用いたCO2・CH4計測における圧力広がり効果の影響
Pressure broadening effects of inert gases on CO2 and CH4 measurements using a wave scan cavity ring down spectrometer

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A wavelength-scanned cavity ring-down spectrometer (CRDS, available from PICARRO, Inc., Santa Clara, CA) is a rapidly spreading observation instrument which can detect atmospheric CO2, CH4, and H2O simultaneously based on the principle of laser absorption technique (Crosson, 2008). Chen et al. (2010) made airborne observations of CO2 and CH4 over the Amazonian rain forest using a CRDS and evaluated its performance for CO2 measurement in comparison to NDIR. These investigators reported the CRDS measurements were affected by the variations in inert gaseous species (N2, O2, and Ar) due to pressure broadening effects (PBE) on absorption spectrum of CO2 and CH4. However, the magnitudes of the pressure broadening effects were not tested. In this work PBE of N2, O2, and Ar on the CO2 and CH4 measurements by means of a wave scan cavity ring-down spectrometer was examined through the experimental approach. Our experiments revealed similar PBE behaviour on CO2 and CH4. The relative increase of N2 in the sample gas shows negative PBE while those of O2 and Ar show positive PBE. Maximum PBE was observed for N2, followed by O2 and minimum for Ar. For example, PBE of N2 on the CO2 measurement at the 2.5% increase is estimated to be -0.93 ppmv while those of O2 and Ar is +0.23 ppmv and +0.01 ppmv, respectively. For CH4, PBE at 2.5% increase is estimated to be -1.08 ppbv while those of O2 and Ar is +0.22 and +0.02 ppbv, respectively. Based on the experimental results, possible PBE during the synthetic standard gas measurements was considered. We inferred substantial PBE for both CO2 and CH4 within +/-0.6 ppmv for CO2 and +/-0.6 ppmv for CH4 during the measurement of the standard gas balanced with the synthetic air consists of N2, O2, and Ar. On the contrary, negligible PBE was estimated empirically up to -0.05 ppmv for CO2 and -0.07 ppbv for CH4 during the measurements of purified air-balanced standard gases. Our results clearly indicated that natural air-based standard gas should be used to remove the possible bias during the ambient air measurements and otherwise purified air-balanced standard gas should be used after the isotope correction
Keywords: cavity ring-down spectrometer, carbon dioxide, methane, pressure broadening, continuous measurements