Continuous Near-IR and Mid-IR CRDS Measurements of Atmospheric CO_2, CH_4, N_2O, and CO in the Megacities Los Angeles Network: Design Criteria

Jooil Kim[1]*, Ray F. Weiss[1], Ralph F. Keeling[1], Matthias Falk[2], Peter K. Salameh[1], William J. Paplawsky[1], Adam C. Cox[1], Timothy J. Lueker[1], Kristal R. Verhulst[3], Riley Duren[3], Christopher D. Sloop[4]

[1] Scripps Institution of Oceanography, UC San Diego, La Jolla, California, USA

[2] California Air Resources Board, Sacramento, California, USA

[3] NASA Jet Propulsion Laboratory, Pasadena, California, USA

[4] Earth Networks, Germantown, Maryland, USA

* Corresponding author: jjkim@ucsd.edu

Greenhouse gas (GHG) measurements in urban areas are an important component in quantifying the global emissions of anthropogenic GHGs. Measurements in these environments share some of the same limitations of background measurements. Station accessibility is often not ideal and requires a high level of autonomous operation, as well as efficient use of resources, including calibration gases and infrequent maintenance visits. The wide ranges of concentrations measured in the urban environment also pose calibration challenges that differ significantly from those at background stations. Previously, Welp et al. (2013) demonstrated a configuration for calibration of a single Picarro cavity ring-down spectrometer (CRDS) infrared (IR) analyser (either model G2301 or G2401), using a temperature-controlled “calibration box” containing a pressure-stabilized Nafion drier and an automated calibration gas switching system. This configuration has been deployed throughout the Los Angeles Megacities network (Verhulst et al., 2017). Here we show that this calibration box can also be employed with two Picarro analyzers (G2301 & G5301) plumbed in parallel downstream, allowing for simultaneous measurements of CO_2, CH_4, N_2O, and CO with calibration gases shared for all four measurements. To use calibration gases efficiently, the flow rates for each instrument have been reduced significantly. Instrument control and data logging is done using the GCWerks software package configured especially for dual-instrument applications. We present details of the configuration design, including results of Allan variance and other tests performed on both Picarro instruments. We also show comparisons between the Picarro G5310 and the Los Gatos Research N_2O/CO Analyzer (Enhanced Performance model with customizations) instruments for mid-IR measurements of N_2O and CO, as well as for CO in the near-IR by the Picarro model G2401. Data from the deployment of the combined Picarro G2301 and G5310 instrument configuration at sites in the Los Angeles Megacities network will also be shown.

References

L. R. Welp, *et al*., Design and performance of a Nafion dryer for continuous operation at CO_2 and CH_4 air monitoring sites. *Atmos. Meas. Tech.*, 6(5), 1217–1226, 10.5194/amt-6-1217-2013, 2013.

K. R. Verhulst, *et al.*, Carbon Dioxide and Methane Measurements from the Los Angeles Megacity Carbon Project: 1. Calibration, Urban Enhancements, and Uncertainty Estimates, *Atmos. Chem. Phys. Discuss.*, https://doi.org/10.5194/acp-2016-850, *in press*, 2017.