Measuring CO, CH_4, CO_2 & H_2O in a Single Instrument; Using New CRDS Technology to Characterize Urban Plumes & the Well-Mixed Atmosphere

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The ability to take inventory of critical greenhouse gases such as carbon dioxide (CO_2) and methane (CH_4) and quantify their sources and sinks is essential for understanding atmospheric change. Attribution of greenhouse gas sources has commonly been done using ^{14}C as a marker for fossil fuel combustion, however, current technology is not able to make continuous, real-time, ^{14}C measurements. As an alternative, researchers have adopted methods using carbon monoxide (CO) as a tracer for combustion emissions in the atmosphere. Therefore, measurement of carbon monoxide alongside relevant greenhouse gases provides a unique tool for characterizing anthropogenic emissions. Using Cavity Ring-Down Spectroscopy (CRDS) technology, Picarro has developed the capability to measure CO_2 concentration to a precision (5 second, one sigma) of 150 parts-per-billion (ppbv), CH_4 concentration to a precision of 1 ppbv, and CO to a precision of 30 ppbv, all within seconds, using the same instrument.

Research and development at Picarro have been focused on incorporating the fast optical switching and other technologies required to enable measurement of four species without compromising the high sensitivity, precision and low drift that make these instruments valuable to atmospheric scientists. In order to best serve the research community, two models have been developed, the G2401 for ground-based measurements and the G2401-*m* for flight-based measurements. The G2401 is designed for terrestrial atmospheric monitoring and is capable of meeting the World Meteorological Organization's data quality objectives for inter-laboratory comparability. The G2401-*m* includes unique pressure and vibration remediation technology to ensure optimal operation during the rapidly changing conditions present during aircraft flight. Current application work using the instruments includes: ground-based urban networks, remote atmospheric monitoring, mobile source identification, and flight-based vertical profiles, urban plume characterization and satellite data verification.

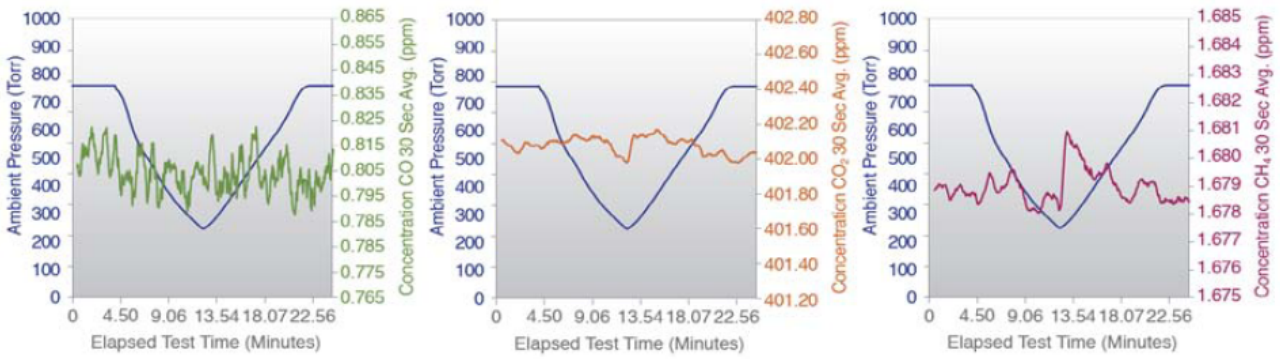

Figure 1. Picarro factory flight simulation test data for CO, CO_2 and CH_4 from a production G2401-*m* instrument. Testing is done in a custom-built hyperbaric chamber. The chamber pressure cycles between 760 to 250 Torr as the analyzer measures a constant-concentration gas stream delivered at the same pressure as the hyperbaric chamber.