Development of High-Precision Gas Analyzers for Measurements of N_2O, CO, CH_4, CO_2, and H_2O

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We report the continued development of two continuous-flow gas analyzers, based on cavity enhanced laser absorption spectroscopy, which measure important atmospheric constituents in real time, with high precision and accuracy, and over a wide range of mixing ratios. One instrument (N_2O+CO Analyzer) uses a tunable continuous-wave quantum cascade laser operating in the wavelength region near 4.56 microns to record measurements of carbon monoxide, nitrous oxide and water vapor in ambient air. The typical precision for continuous measurements at typical ambient levels of either CO or N_2O is about 0.1 ppbv (1-sigma, 10-second measurement time). The instrument also reports water vapor mixing ratio measurements simultaneously and employs those measurements to determine the effects due to dilution and line broadening to allow accurate determination of mixing ratios (CO, N_2O) on a dry basis.

The other instrument uses two tunable continuous-wave near-infrared telecommunications-grade diode lasers operating in the wavelength regions near 1.6 and 1.65 microns to record measurements of carbon dioxide and methane in ambient air. This instrument employs an internal thermal control system to allow extremely low drift despite changes in ambient temperatures over the range from 0 to 40 degrees C. The instrument also reports water vapor mixing ratio measurements simultaneously and employs those measurements to accurately quantify the effects due to dilution and line broadening and provide accurate determination of the measured mixing ratios (CO_2, CH_4) on a dry basis. Both of these instruments require relatively low-power (150-250 watts) and no liquid nitrogen thus allowing for easy measurements in the field.

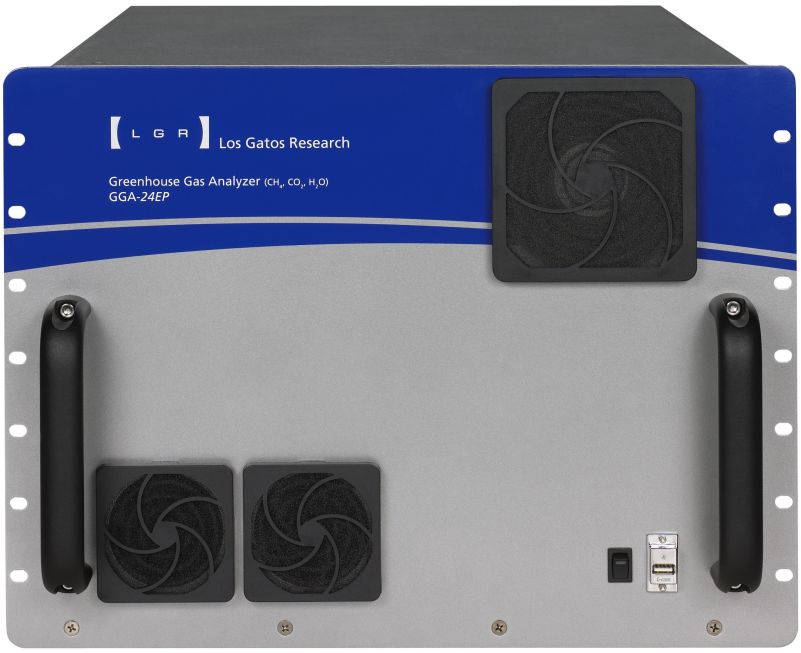

Figure 1. Thermally-stabilized gas analyzer provides simultaneous measurements of methane, carbon dioxide and water vapor.