HIGH-PRECISION MEASUREMENTS OF CARBON DIOXIDE, METHANE AND WATER VAPOR FOR ATMOSPHERIC INVERSION AND EDDY COVARIANCE FLUX BASED ON CAVITY RINGDOWN SPECTROSCOPY

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Field deployable instrumentation that measures carbon dioxide, methane, and water vapor with both high-accuracy and high-precision would reduce the uncertainty in the determination of terrestrial sources and sinks of these dominant greenhouse gases, resulting in improved predictive models and a deeper understanding of the global carbon cycle.

Existing atmospheric monitors based on non-dispersive infrared sensors have known problems — they are non-linear, sensitive to water vapor concentration, and susceptible to drift. Furthermore, these instruments require extensive modifications and sample conditioning, frequent zero and span calibrations, and significant post processing of the data. Additionally, many cannot easily be calibrated simultaneously from site to site to the level of accuracy required for use in atmospheric inversion studies.

Picarro has developed a line of high-precision carbon dioxide/methane/water vapor analyzers for atmospheric inversion and Eddy Covariance Flux measurements that maintain high linearity, precision, and accuracy over changing environmental conditions, with minimal calibration. The outstanding performance is based on a combination of the unique capabilities of the underlying optical absorption technology, Cavity Ringdown Spectroscopy (CRDS), and engineering designed to maximize the inherent advantages of CRDS including a high-precision wavelength monitor that ensures only the spectral absorption feature of interest is being monitored. Precise temperature and sub-torr pressure control enables excellent accuracy from analyzer to analyzer and low drift over time— important considerations for a network of measurement sites. The extremely compact cell size gives the analyzer fast rise and fall times at very small flow rates translating into significantly reduced calibration gas volumes and enabling a true 10 Hz response. Because the analyzers do not require sample conditioning or frequent calibration and maintain high linearity, precision, and accuracy over changing environmental conditions, these analyzers could significantly improve the accuracy and precision of greenhouse gas measurements while reducing the operating costs of monitoring, enabling higher density deployment.