Performance Validation of New High-precision CH_4 and CO_2 Analyzers Based on Optical Feedback Cavity Enhanced Absorption Spectroscopy

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Atmospheric carbon dioxide (CO_2) and methane (CH_4) measurements require instruments that are accurate, precise, and stable. Often these measurements are conducted in remote locations and require instrumentation that are robust, low power, and with minimal maintenance. In this presentation we report on progress towards the development of two instruments based on optical feedback cavity enhanced absorption spectroscopy that provide high-precision measurements of CH_4 (1σ=0.25 ppb, at 2 ppm CH_4 in dry air, 5-second averaging) and CO_2 (1σ=25 ppb, at 400 ppm CO_2 in dry air, 5-second averaging). We present results that show very low drift with temperature across the range from -20 to 45° C. In addition, both instruments measure the water vapor (H_2O) mole fraction in the sample and use that to perform the necessary correction for dilution and line broadening such that the reported CO_2 and CH_4 dry mole fractions are accurate from 0-4% H_2O.

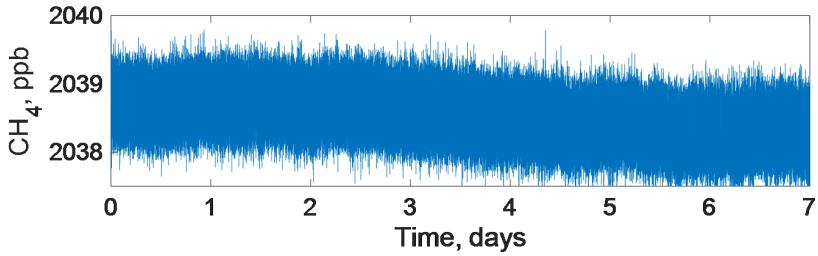

Figure 1. Continuous 1Hz measurements of cylinder air for 7 days.

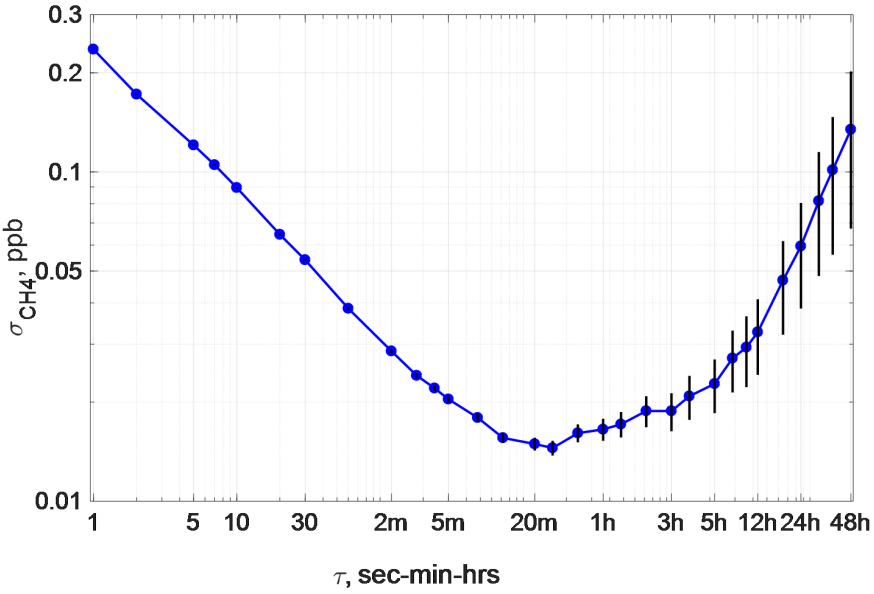

Figure 2. Allan deviation plot from 7 days of CH_4 measurement.