Development of Trace Carbon Dioxide Isotopologue Analyzer - Performance Evaluation Study

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Introduction

We report on the development and performance evaluation of a soon-to-be released trace gas analyzer for the measurement of atmospheric $\delta^{13}C$, $\delta^{18}O$, $\delta^{17}O$, ^{13}C, ^{12}C, ^{18}O and ^{17}O of CO_2. Carbon Dioxide isotopes can help answer many questions, such as emission source attribution and, via their use as a tracer, to examination of naturally occurring processes in plants or soil. Based on Optical Feedback Cavity Enhanced Absorption Spectroscopy (OF-CEAS), the analyzer offers both the sensitivity and stability necessary for long-term atmospheric monitoring , DIC ocean measurements, soil, plant physiology and mud gas isotope logging applications.

Analyzer Specifications

- Total Weight: 10.5 kg (including batteries)
- Battery Life: 8 hours typical with 2 batteries
- Operating temperature range -25 °C to + 45 °C

LI-7825 CO_2 Isotope Analyzer

CO_2 Measurements:
Measurements: Range: 50 to 2,000 ppm
Precision (1σ): 0.027 ppm with 5-minute averaging
Maximum drift: <0.4 ppm per 24-hour period

$\delta^{13}C$ Measurements:
Precision (1σ): 0.02 ‰ with 5-minute averaging
Maximum drift: <0.5 ‰ per 24-hr period

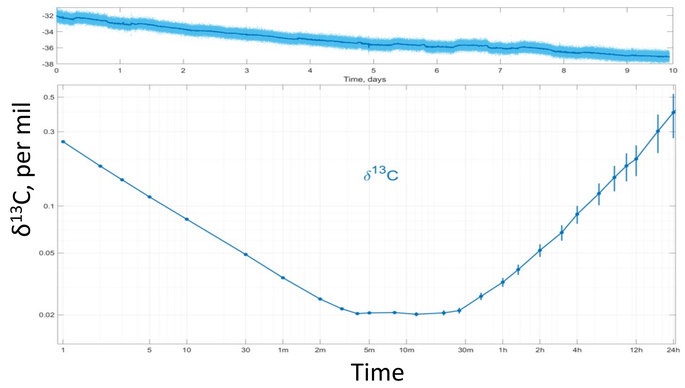
$\delta^{18}O$ Measurements:
Precision (1σ): 0.06 ‰ with 5-minute averaging
Maximum drift: <2 ‰ per 24-hr period

$\delta^{17}O$ Measurements:
Precision (1σ): 0.2 ‰ with 5-minute averaging
Maximum drift: <6 ‰ per 24-hr period

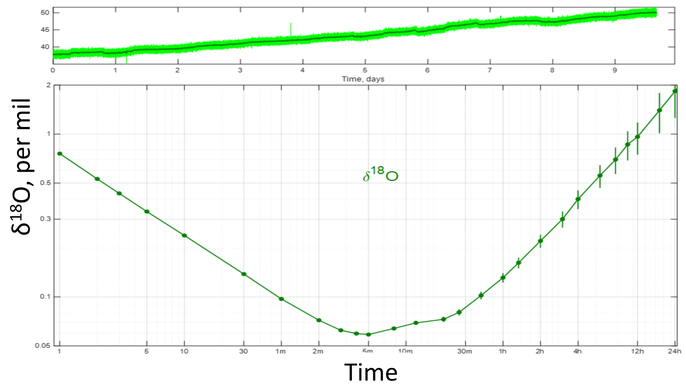
Test Setup

Data for the Allan Deviation plots were collected over a 10-day period, where, prior to the measurement of test gas, the LI-7825 prototype was powered on/warmed up while sampling ambient air for 24 hours. It was then connected to a 400 ppm CO_2 tank via stainless steel tubing for the test.

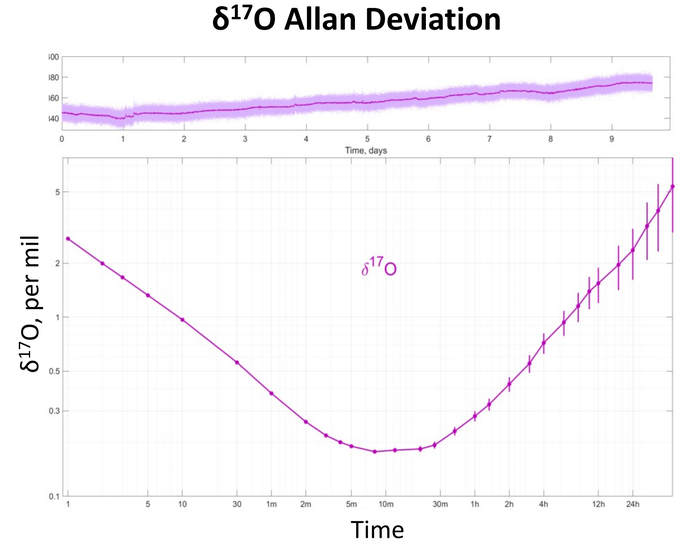
$\delta^{13}C$ Allan Deviation



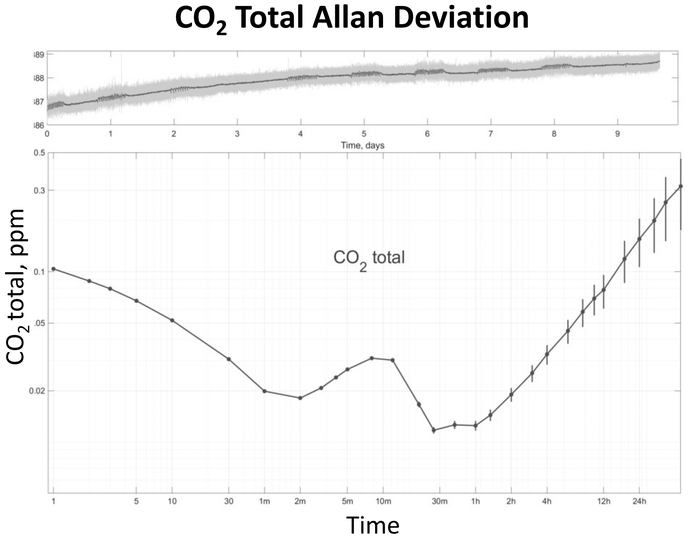
$\delta^{18}O$ Allan Deviation



$\delta^{17}O$ Allan Deviation



CO_2 Total Allan Deviation



Conclusions

In conclusion, this portable and rugged instrument meets or exceeds requirements for both long-term atmospheric background measurements and offers a versatile platform for a range of mobile and agile measurements relevant to the better understanding of greenhouse gas emissions from anthropogenic and natural sources.

Acknowledgements

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Visit https://www.licor.com/env/products/trace_gas/LI-7825 or contact bj.clark@licor.com for further details