AERODYNE RESEARCH, Inc.

Aerodyne Mini-TILDAS CO_2 Isotope Monitor

Unprecedented precision and time response for $\delta^{13}C$ and $\delta^{18}O$ isotope ratios in a compact, transportable package.

Features:

- < 0.10 ‰ precision for $\delta^{13}C$, $\delta^{18}O$ in 1 s
- < 0.03 ‰ precision for $\delta^{13}C$, $\delta^{18}O$ in 100 s
- Fast time response (10 Hz)
- Direct measurement of CO_2 isotopes in air without sample processing
- Option for sample-reference valve-switching scheme for enhanced sensitivity with discrete samples
- Dual laser package allows simultaneous measurement of water isotopes or $^{12}C^{17}O^{16}O$ or "clumped" CO_2: $^{13}C^{18}O^{16}O$.

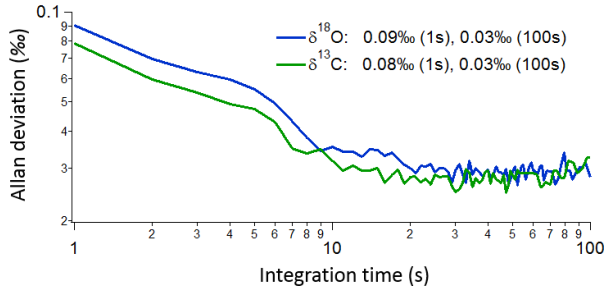
Rugged, field-ready instruments

Direct absorption spectroscopy allows for highly specific and accurate gas detection

Mid-IR detection enables maximum measurement sensitivity

TILDAS Technology

Aerodyne instruments use tunable infrared laser direct absorption spectroscopy (TILDAS) at mid-IR wavelengths to probe molecules at their strongest "finger-print" transition frequencies. We further enhance sensitivity by employing a patented multi-pass broad-band absorption cell that provides optical path lengths up to 76 m. Direct absorption spectroscopy allows for fast (<1 sec) absolute trace gas concentrations without need for elaborate calibration procedures. Moreover, TILDAS instruments are free of measurement interference from other molecular species, enabling extremely specific detection.



Applications

- Determination of atmospheric sources, sinks, and transport through CO_2 isotopic ratios.
- Biosphere exchange.
- Laboratory measurements of discrete samples.
- Mobile measurements aboard aircraft, marine, and ground-based platforms.
- Carbon capture and sequestration monitoring.
- Breath analysis.

Aerodyne CO_2 Isotope Advantages

- Measurement precision comparable to much larger and more expensive IRMS instruments.
- Time response up to 10 Hz enables eddy covariance studies.
- Powerful TDLWintel software provides flexible instrument control, and real-time data analysis.
- Valve control capable of complex scheduling and automatic background and calibrations.
- 19" rack mountable for easy installation.
- Turn-key design allows unattended operation in remote field sites.

AERODYNE RESEARCH, Inc. 45 MANNING ROAD, BILLERICA, MA 01821 (978) 663 9500
www.aerodyne.com CAEC_CO2_1

Performance Specifications:

Isotope ratio precision (1σ)

	1 sec	100 sec
$\delta^{13}C$	0.1 ‰	0.03 ‰
$\delta^{18}O$	0.1 ‰	0.03 ‰
$\delta^{17}C$	0.4 ‰	0.15 ‰

Species Precision (1σ @ 400 ppm CO_2)

	1 sec	100 sec
CO_2	25 ppb	10 ppb

Time Response

1-10 Hz data rate
0.05 s minimum Rise/Fall time (1/e)
(depends on vacuum pump)

Dynamic Range (air)

	min	max
CO_2	0 ppm	5,000 ppm

Enhanced Measurement Options

16 channel valve control for complex sampling

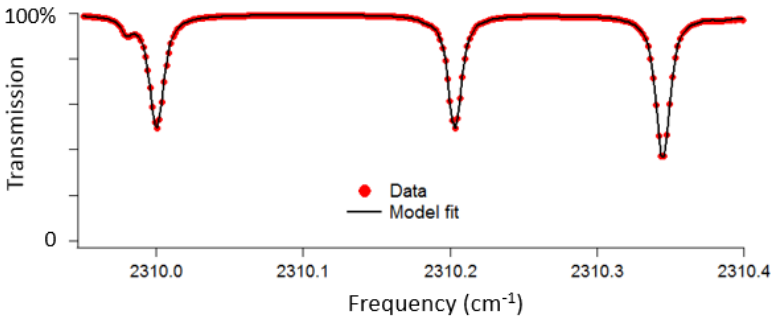
Low volume multi-pass cell for limited sample size

Using the dual laser package:

Simultaneously measure the isotopologues of water ($H^{16}OH$, $H^{18}OH$, $H^{16}OD$).

Simultaneously measure $^{12}C^{17}O^{16}O$ and the "clumped" CO_2 isotopologue $^{13}C^{18}O^{16}O$.

Experimental spectrum acquired at 1 Hz



Installation

19" rack mountable or benchtop

Instrument Operations

Operating temperature: 10 to 35 °C
Sample flow rate: 0 to 20 slpm

Instrument Components

Core instrument
Thermoelectric chiller
Keyboard, mouse, and monitor
Vacuum pump (customer specified)
Inlet sampling system (customizable)

Data Outputs

RS-232, USB drive, ethernet

Size, Weight, Power

Dimensions:430mm x 660mm x 270mm
Weight: 35 kg (core instrument) + 15 kg (chiller) + pump weight
Max power: 125 W, 120/240 V, 50/60 Hz (core instrument)
+ 300 W (chiller) + pump power

Aerodyne specializes in collaboration and custom design. Please contact us if you would like to discuss additional measurement options and applications.

REFERENCES:

McManus, J. Barry, David D. Nelson, and Mark S. Zahniser. "Design and performance of a dual-laser instrument for multiple isotopologues of carbon dioxide and water." *Optics express* 23.5 (2015): 6569-6586.

Wehr, R., et al. "Long-term eddy covariance measurements of the isotopic composition of the ecosystem–atmosphere exchange of CO 2 in a temperate forest." *Agricultural and forest meteorology* 181 (2013): 69-84.

McManus, J. B., et al. "A high precision pulsed quantum cascade laser spectrometer for measurements of stable isotopes of carbon dioxide."*Journal of Modern Optics* 52.16 (2005): 2309-2321.