CaTeC
MEETINSTRUMENTATIE
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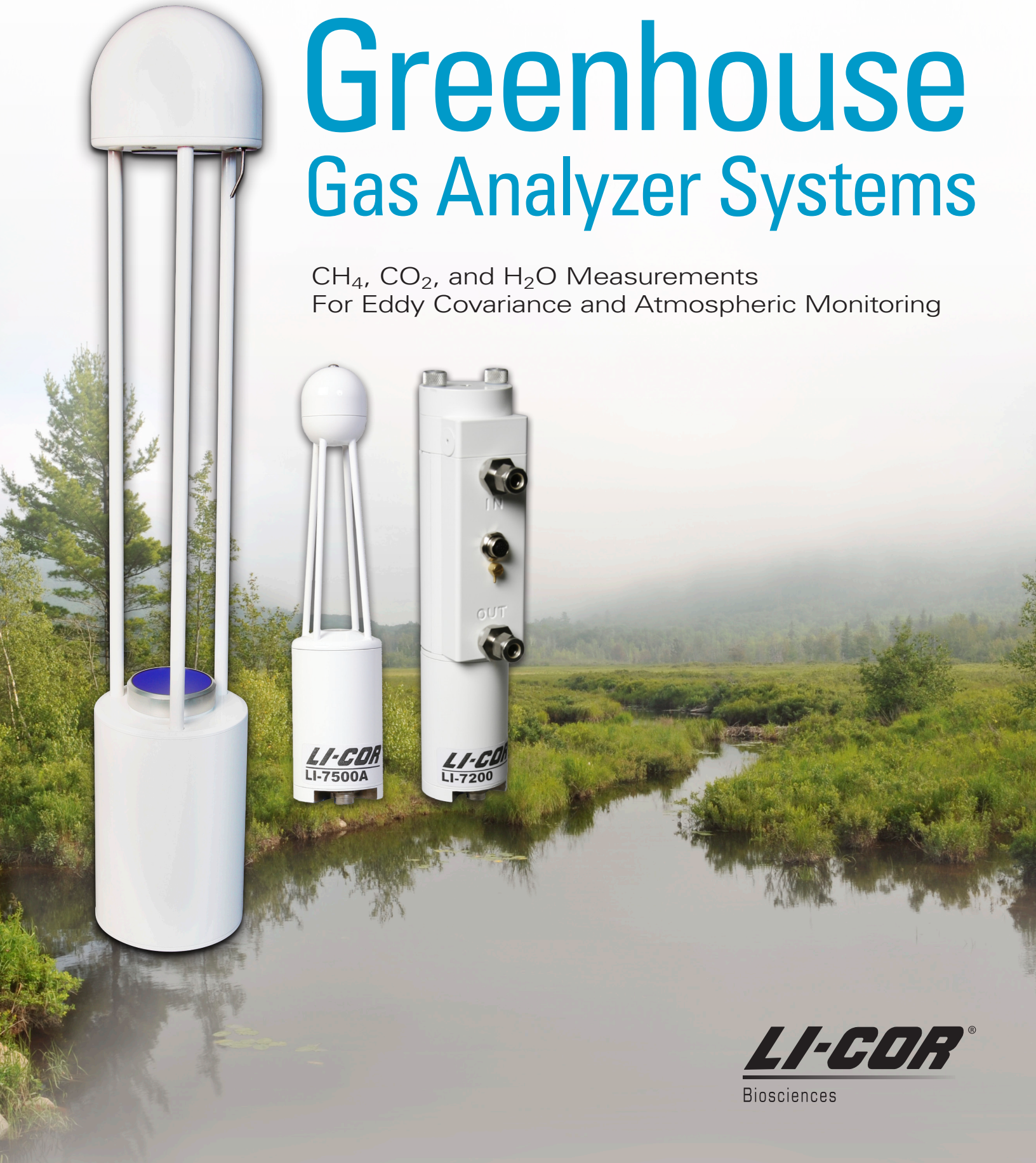
Greenhouse Gas Analyzer Systems

CH_4, CO_2, and H_2O Measurements
For Eddy Covariance and Atmospheric Monitoring



LI-COR®
Biosciences

Advantages of LI-COR Greenhouse Gas Analyzer Systems:

Designed for eddy covariance and atmospheric flux measurements

- **High accuracy**
- **Excellent stability**
- **High precision***
  - **5 ppb CH_4**
  - **0.11 ppm CO_2**
  - **4.7 ppm H_2O**
- **Fast response (up to 20 Hz bandwidth)**

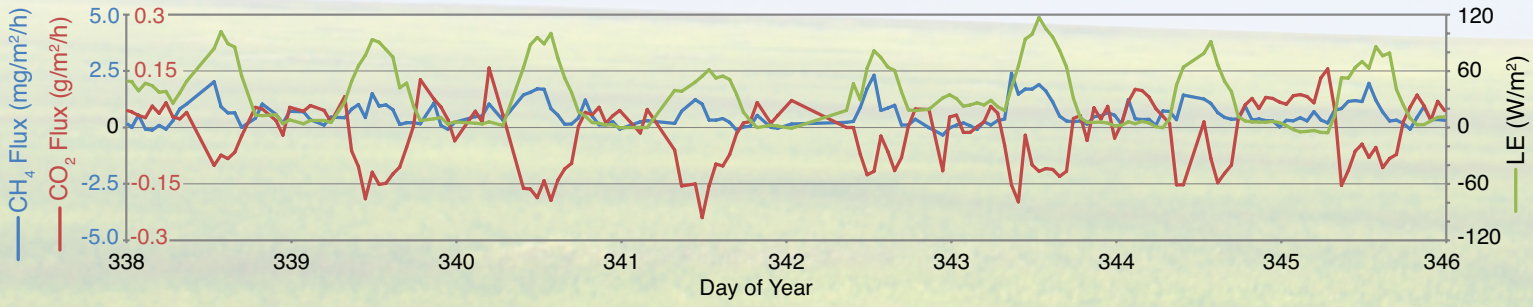
Designed for use in extreme environments

- **Low power requirements**
- **Light weight**
- **Rugged and reliable**
- **Wide operating temperature range (-25 to 50 °C)**

*RMS noise at 10 Hz and typical ambient concentrations

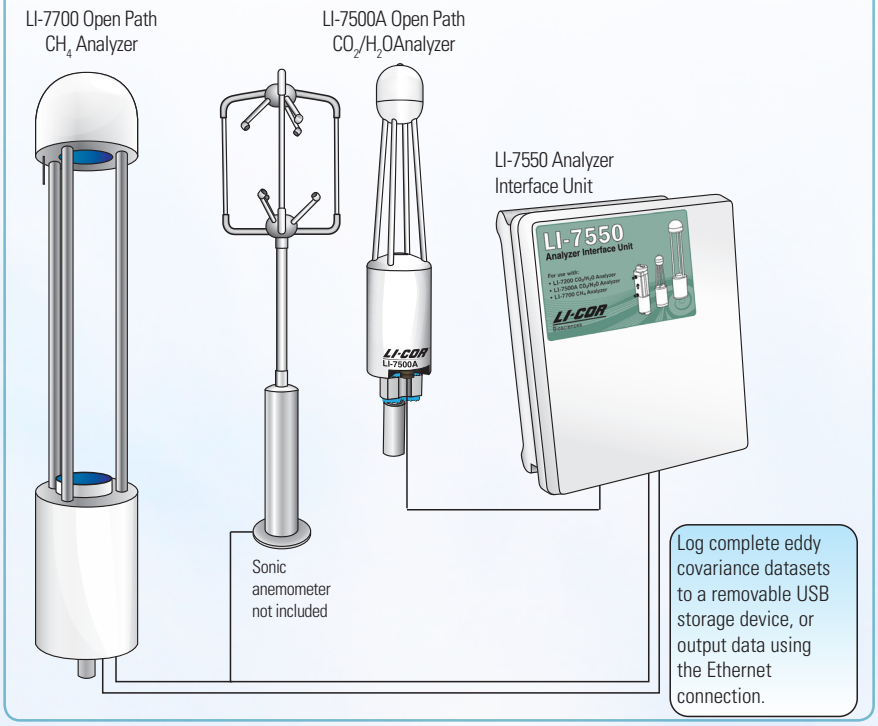
Innovative Solutions

LI-COR Biosciences' Greenhouse Gas (GHG) analyzer systems are designed to provide simultaneous *in-situ* methane, carbon dioxide, and water vapor concentration data for eddy covariance applications. They are optimized for use in extreme environments where limited power is available. The LI-7700 Open Path CH_4 Analyzer, which is included with both GHG-1 and GHG-2, features temperature controlled mirrors, automated mirror cleaning, and a radiation shield. Both the LI-7500A Open Path CO_2/H_2O Analyzer (GHG-1) and the LI-7200 Enclosed CO_2/H_2O Analyzer (GHG-2) feature a low chopper motor housing temperature setting for additional energy savings in cold climates. Both operate with low power requirements, while the LI-7200 is optimized for use in environments where rain, snow, or fog could interrupt measurements.

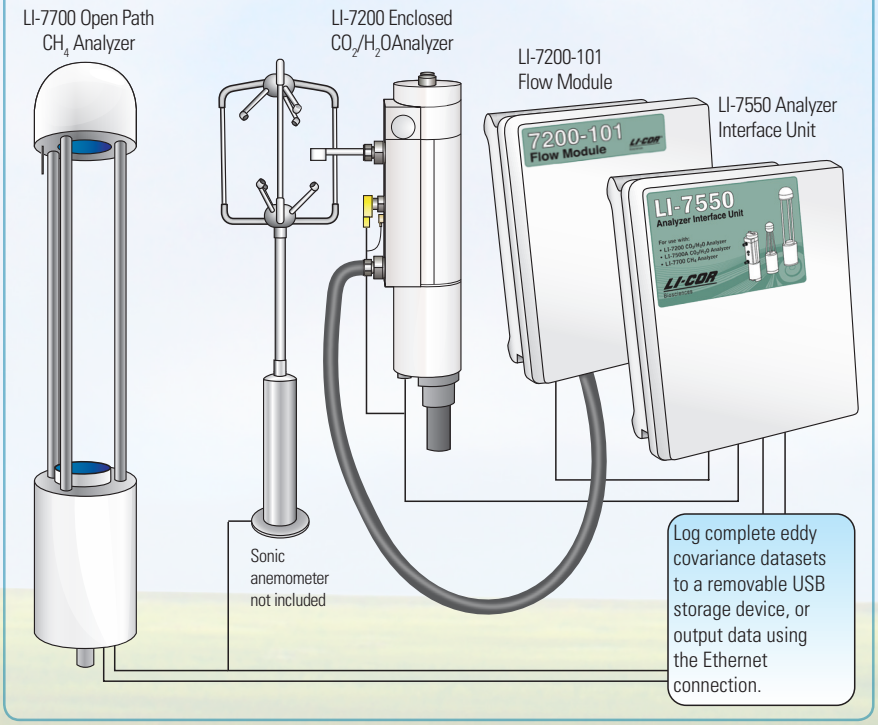


The figure above shows methane, carbon dioxide, and latent energy fluxes measured with the eddy covariance technique over the Florida Everglades. These data are a subset of a 6 week data set collected during the winter of 2008 and 2009, at 3.5 m above the canopy, using an LI-7500 Open Path CO_2/H_2O Analyzer and an LI-7700 Open Path CH_4 Analyzer. They show a negative flux of CO_2, but positive CH_4 and LE fluxes for the measurement period, so we know that this ecosystem was a sink of carbon dioxide and a source of methane and water vapor.

Greenhouse Gas Package 1



Greenhouse Gas Package 2



Advanced Technology

Wavelength Modulation Spectroscopy (WMS) is an advanced laser detection technique that made it possible to design the LI-7700 Open Path CH_4 Analyzer. The LI-7700 operates at ambient temperatures and requires only 8 W of power during normal operation, while providing the precision, speed, and accuracy required for the eddy covariance method. WMS is advantageous for field research because it has relatively high resistance to contamination in the optical path, and measurements are made at ambient pressure.

Both the LI-7200 and LI-7500A make precise, accurate and fast CO_2/H_2O measurements using non-dispersive infrared (NDIR) detection. NDIR has consistently proven to be an excellent technology for measuring CO_2 and H_2O at high precision and high speeds with low power consumption. In the 24 years since LI-COR Biosciences introduced our first precision NDIR instrument, we have continuously worked to improve the measurement technology. The results of this ongoing effort are found in the fast, accurate, and reliable data that our analyzers provide.

Simplifying Eddy Covariance

LI-COR's greenhouse gas analyzer systems facilitate the collection of eddy covariance data sets by logging complete CH_4, CO_2, H_2O and wind speed data to a removable USB storage device. In addition, data can be output via the Ethernet connection to a computer or network.

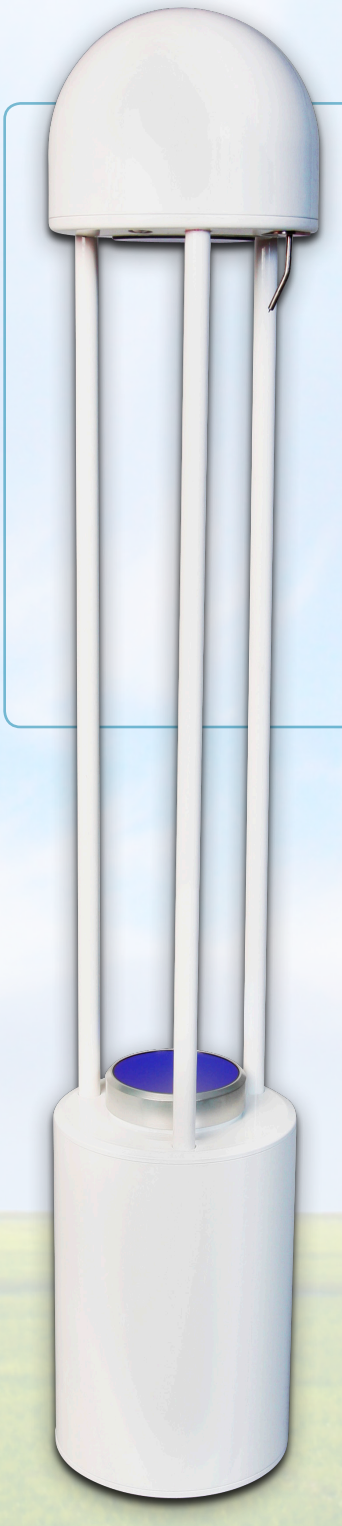
Both the LI-7700 and the LI-7550 Analyzer Interface Unit provide four general ±5 V inputs for analog data from any fast sonic anemometer, (including Campbell® Scientific[1], Gill Instruments[2], Metek[3], Applied Technologies[4], Kaijo[5], RM Young[6], or others). All the instruments in GHG packages 1 and 2 are designed to operate on basic solar/ battery power systems or small generators - so they can be deployed virtually anywhere in the world.

Need more information? Contact us to discuss the specific needs of your application.

When our engineering and scientific teams set out to design instruments for eddy covariance research, they consult with leading researchers in the field. This ensures that our instruments provide new research opportunities and feature the high precision, accuracy, and stability that scientists demand. Our new greenhouse gas analyzers incorporate ideas from flux researchers around the world and use state-of-the-art technology to provide some of the most durable and versatile trace gas measurement systems available. Our gas analyzer packages include numerous innovations that simplify the collection of eddy covariance data sets, including additional input channels for sonic anemometer data and Ethernet output for using external data loggers. And, our team of experienced Application Scientists and Analysts are here to help you get the most from your instrumentation.

Greenhouse Gas Package 1

GHG-1 package includes the **LI-7700 Open Path CH_4 Analyzer**, **LI-7500A Open Path CO_2/H_2O Analyzer** (with the **LI-7550 Analyzer Interface Unit**), and a **7550-101 Auxiliary Sensor Interface**. This system provides a complete solution for greenhouse gas flux measurements, especially in remote areas where available power is limited.



GHG-1 Features

- **Measures CH_4, CO_2, and H_2O with 20 W of power**
- **Operates without filters or pumps**
- **No time delays or signal attenuation due to tubing**
- **Sensors are easily co-located with the sonic anemometer sample volume**

LI-7500A Open Path CO_2/H_2O Analyzer

- Based on the proven LI-7500.
- The lowest power CO_2/H_2O analyzer.
- Low chopper motor temperature setting provides additional energy savings in cold climates.
- Includes the LI-7550 Analyzer Interface Unit, which houses digital signal processing electronics for the LI-7500A.
- High precision, fast response.
- Provides versatile output options.
- 4 analog inputs for data from a sonic anemometer.

Greenhouse Gas Package 2

GHG-2 package includes the **LI-7700 Open Path CH_4 Analyzer**, **LI-7200 CO_2/H_2O Analyzer** (includes the **LI-7550 Analyzer Interface Unit**), **7200-101 Flow Module** and the **7550-101 Auxiliary Sensor Interface**. This system provides an integrated solution for greenhouse gas flux measurements in environments with frequent rain, snow, or fog.

GHG-2 Features

- **Measures CH_4, CO_2, and H_2O with 35 W of power**
- **Flow Module integrates flow rate and diagnostic data with the data set**
- **Short intake tube (typically 0.5 to 1.0 m) minimizes time delays from tubing for CO_2/H_2O**
- **90-95% temperature attenuation for CO_2/H_2O measurements, minimal water vapor attenuation**
- **Sensors are easily co-located with the sonic anemometer sample volume**

LI-7700 Open Path CH_4 Analyzer

- Low power requirements.
- High speed, high precision methane density measurements.
- Self-cleaning mirror minimizes maintenance requirements.
- Temperature controlled mirrors and a radiation shield reduce condensation in the optical path.
- 4 analog and 3 type E thermocouples inputs.

LI-7200 Enclosed CO_2/H_2O Analyzer

- Based on the proven LI-7500.
- Designed to provide continuous CO_2/H_2O measurements through rain, fog, and snow.
- Includes the 7200-101 Flow Module.
- Includes the LI-7550 Analyzer Interface Unit, which houses digital signal processing electronics for the LI-7200.
- High precision, fast response.
- Provides versatile output options.
- 4 analog inputs for data from a sonic anemometer.

Specifications* (GHG Packages 1 & 2)

LI-7700 (GHG-1 and GHG-2)

	CH_4
Calibration Range:	0-40 ppm @ 25 °C 0-25 ppm @ -25 °C
Bandwidth:	1, 2, 5, 10, or 20 Hz
Linearity:	Within 1% across full calibration range
Resolution:	5 ppb (RMS @10 Hz, typical ambient levels)
Operating Pressure Range:	50 to 110 kPa
Detection Method:	Wavelength Modulation Spectroscopy, 2f Detection
Inputs:	Ethernet; 4 single ended analog, ±5 V, 16 bit; 3 type E thermocouple

GHG-1 and GHG-2

Data Storage:	Removable USB data logging (stores CH_4, CO_2, H_2O, and windspeed data; 4 GB industrial grade USB drive included)
Data Communcation:	Ethernet
Power Requirements:	10.5 to 30 VDC
Power Consumption	
GHG-1:	20 W nominally
GHG-2:	35 W nominally
Operating Temperature Range:	-25° C to 50 °C (-40 °C verification test available for LI-7500A and LI-7200)
Weight	
GHG-1:	10.4 kg (22.8 lbs)
GHG-2:	17.6 kg (38.6 lbs)
User Interface:	Windows® Software

LI-7500A (GHG-1) and LI-7200 (GHG-2)

	CO_2	H_2O
Calibration Range:	0-3000 ppm	0-60 ppt
Bandwidth:	5, 10, or 20 Hz	
Accuracy:	Within 1% of reading	Within 2% of reading
Resolution: (typical RMS @ 370 ppm CO_2 and 10 mmol mol^{-1} H_2O)	5 Hz 0.08 ppm 10 Hz 0.11 ppm 20 Hz 0.16 ppm	0.0034 ppt 0.0047 ppt 0.0067 ppt
Gain Drift: (% of reading per °C)	±0.02% typical ±0.1% max. @ 370 ppm	±0.15% typical ±0.30% max. @ 20 ppt
Zero Drift: (per °C)	±0.1 ppm typical ±0.3 ppm max.	±0.03 ppt typical ±0.05 ppt max.
Direct Sensitivity to H_2O: (mol CO_2/mol H_2O)	±2.00E-05 typical ±4.00E-05 max.	--- ---
Direct Sensitivity to CO_2: (mol H_2O/mol CO_2)	--- ---	±0.02 typical ±0.05 max
Detection Method:	Non-dispersive Infrared (NDIR) Detection	
Inputs:	Ethernet; 4 differential analog, ±5 V, 16 bit	

*All specifications subject to change without prior notice.

Ordering Information

GHG-1 Package Includes:

LI-7700 Open Path CH_4 Analyzer, 5 m power and Ethernet cables, calibration fixture, washer assembly, mounting hardware, radiation shield, spares kit, carrying case, Windows software CD, and instruction manual.

LI-7500A Open Path CO_2/H_2O Analyzer, LI-7550 Analyzer Control Unit, 5 meter IRGA cable, USB-to-serial adapter, 5 meter data cables (RS-232, Ethernet, DAC), calibration fixture, Windows software CD, and instruction manual.

7550-101 Auxiliary Sensor Interface for analog inputs.

Accessories:

Analog input cables are available for connecting Campbell Scientific and Gill sonic anemometers directly to the LI-7700 and LI-7550.

7550-101 Auxiliary Sensor Interface for analog inputs.

Analog Input Cable (5 m) p/n 392-10109.

High-speed sonic anemometers are available with gas analyzer purchases. Contact LI-COR for details.

GHG-2 Package Includes:

LI-7700 Open Path CH_4 Analyzer, 5 m power and Ethernet cables, calibration fixture, washer assembly, mounting hardware, radiation shield, spares kit, carrying case, Windows software CD, and instruction manual.

LI-7200 CO_2/H_2O analyzer, LI-7550 Analyzer Control Unit, 7200-101 Flow Module, 1 m intake tube with insect screen, 5 meter IRGA cable, USB-to-serial adapter, 5 meter data cables (RS-232, Ethernet, and DAC), Windows software CD, and instruction manual.

7550-101 Auxiliary Sensor Interface for analog inputs.

[1] Campbell Scientific, Inc., Logan UT
[2] Gill Instruments Ltd., Lymington Hampshire, UK
[3] Metek GmbH, Germany
[4] Applied Technologies, Inc., Longmont CO
[5] Kaijo Sonic Corporation, Japan
[6] RM Young, Traverse City, MI

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The LI-COR board of directors would like to take this opportunity to return thanks to God for His merciful providence in allowing LI-COR to develop and commercialize products, through the collective effort of dedicated employees, that enable the examination of the wonders of His works.

"Trust in the LORD with all your heart and do not lean on your own understanding. In all your ways acknowledge Him, and He will make your paths straight."
—Proverbs 3:5,6