

Development of a Portable Trace Nitrous Oxide Analyzer based on Optical Feedback Cavity Enhanced Absorption Spectroscopy

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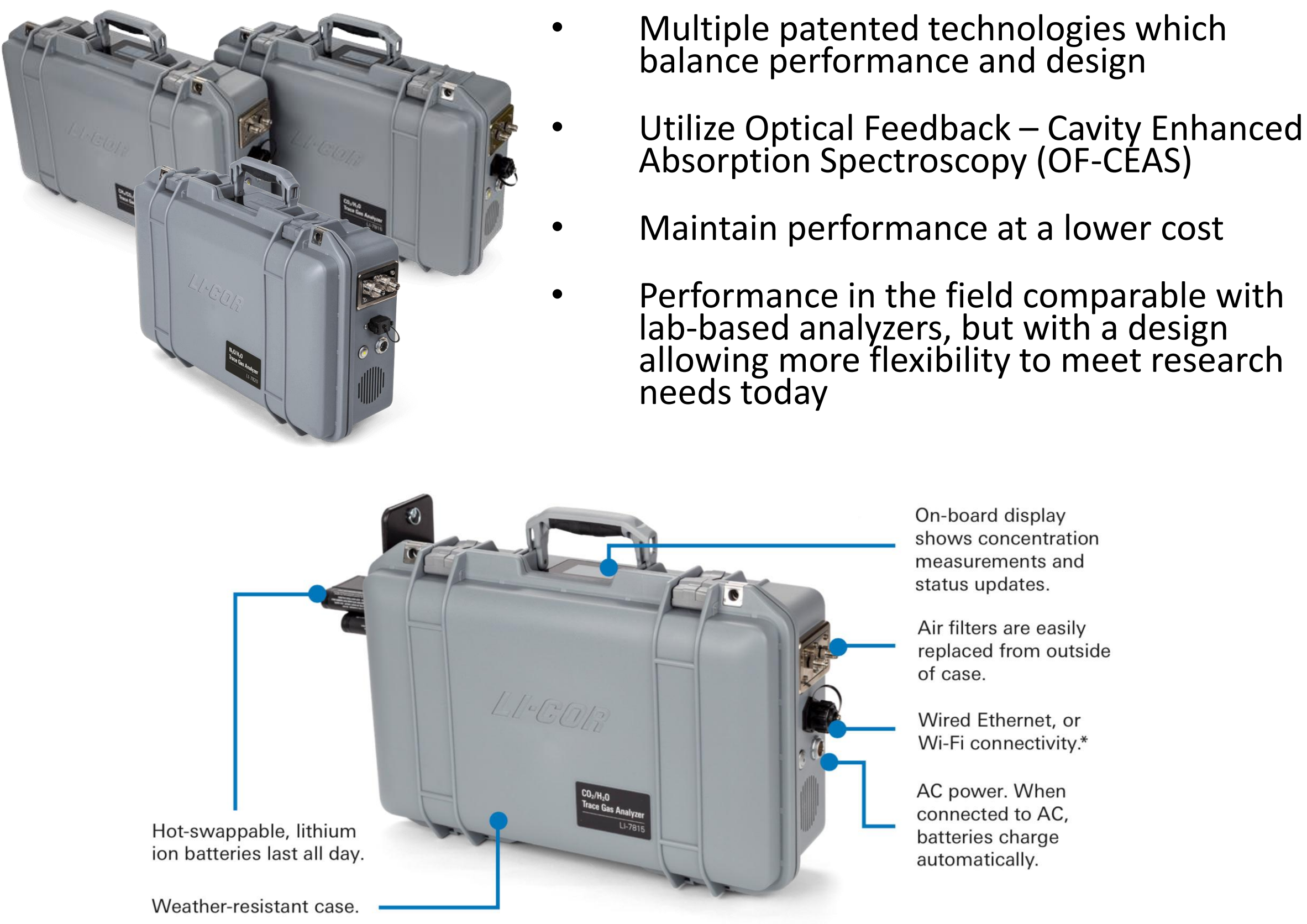
Overview

- LI-COR Biosciences
- Trace Gas Analyzer platform
 - Platform and model-specific specifications
 - Measurement principle
 - N₂O measurement performance
- Soil flux measurements
 - Sources of N₂O from soil
 - Basic theory
 - Determination of Minimum Detectable Flux (using N₂O as an example)

LI-COR Biosciences



Trace Gas Analyzer Platform



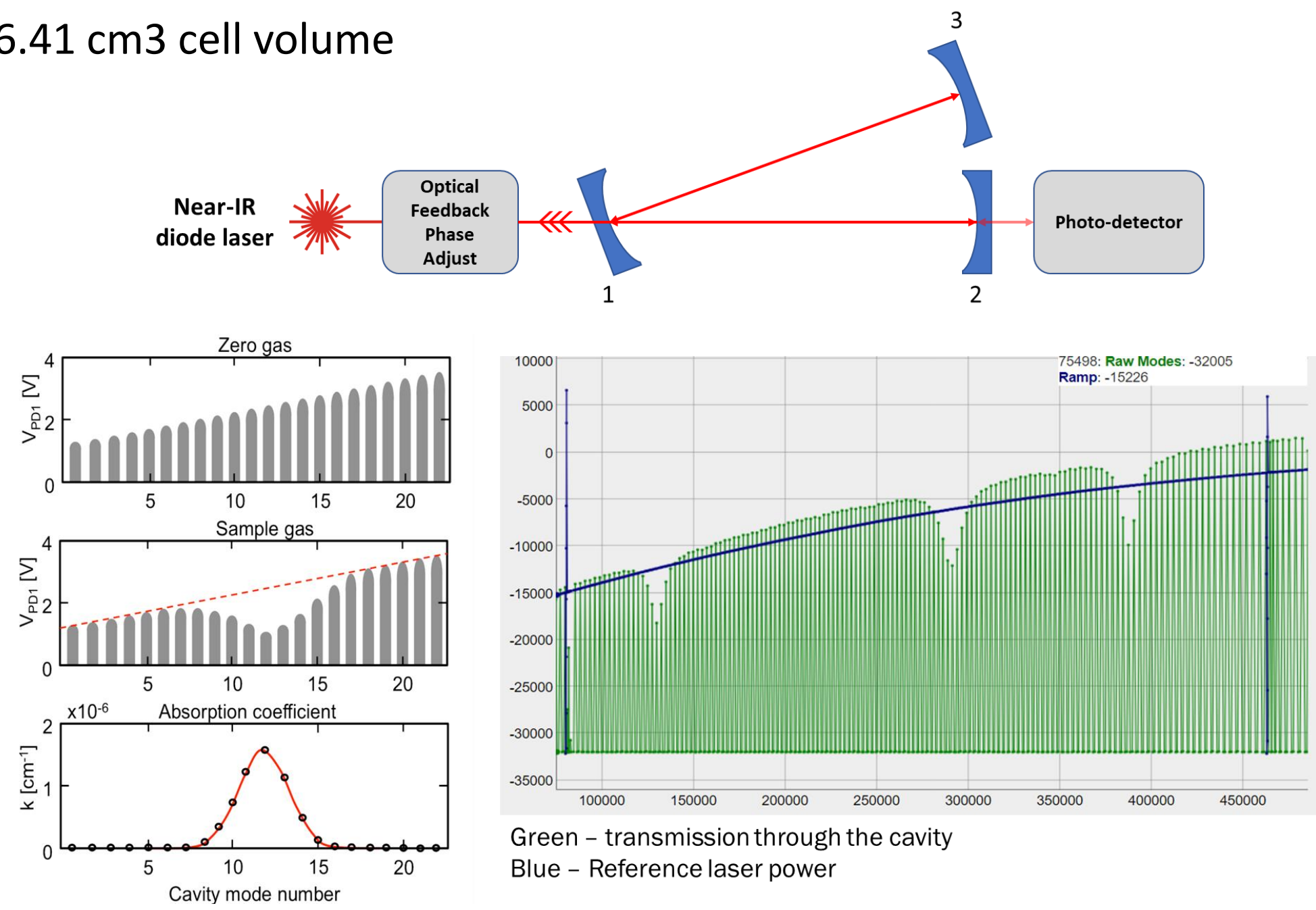
General Specifications

- Temperature range: -25°C to 45°C
- Operating pressure: 70 to 110 kPa
- Weight: 10.5 kg with batteries
- Internal Data Storage: ~3 month
- Measurement rate: 1 sample per second
- Flow rate: 280 sccm (optional 70 sccm)



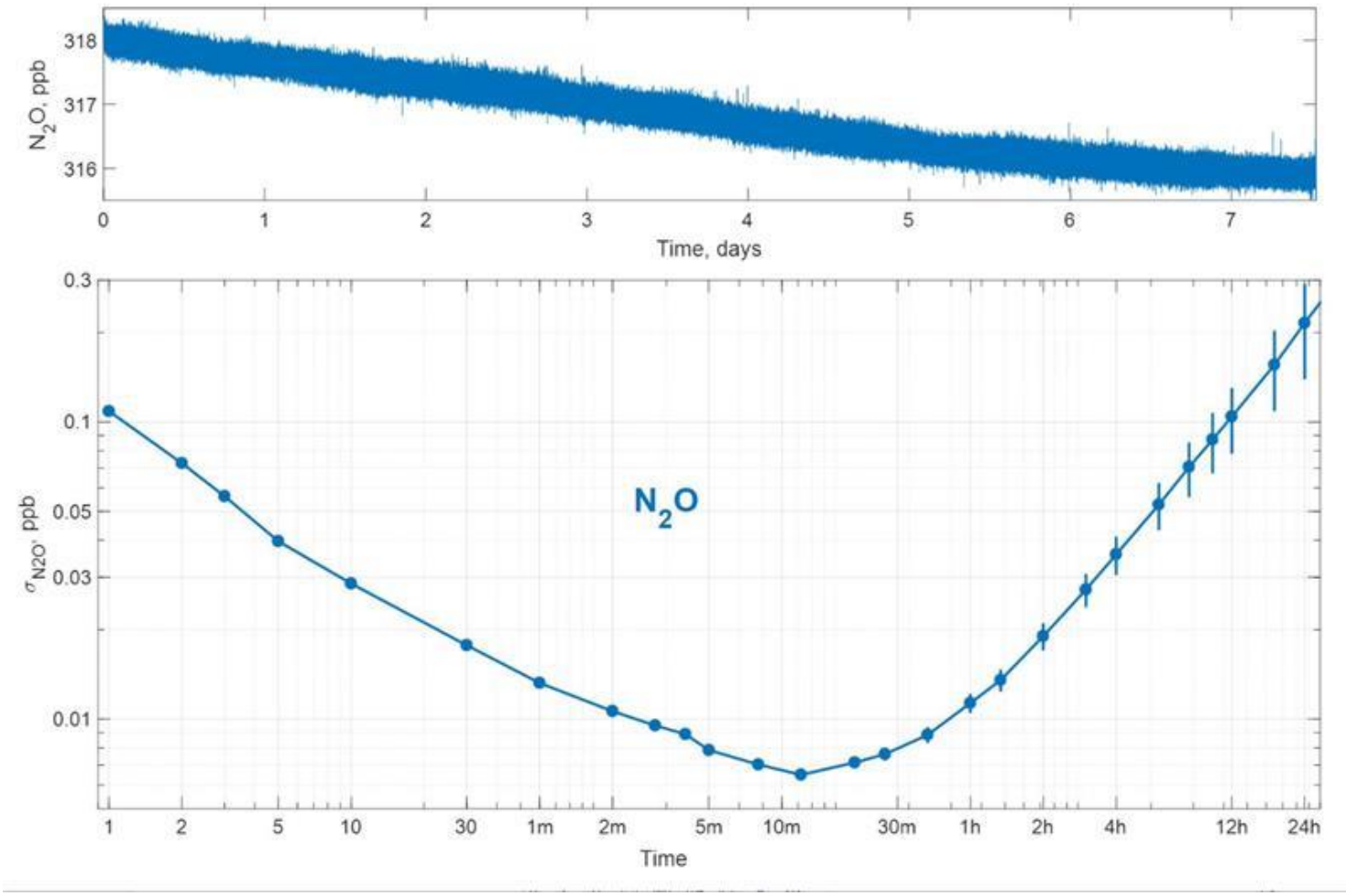
Optical Feedback Cavity Enhanced Absorption Spectroscopy

- V-shaped optical cavity
- Robust near-infrared diode laser
- High reflectivity mirrors (R=0.9999 or T=100 ppm)
- Light is 'trapped' in between the mirrors, greatly increasing effective path-length
- km path-length
- 6.41 cm³ cell volume

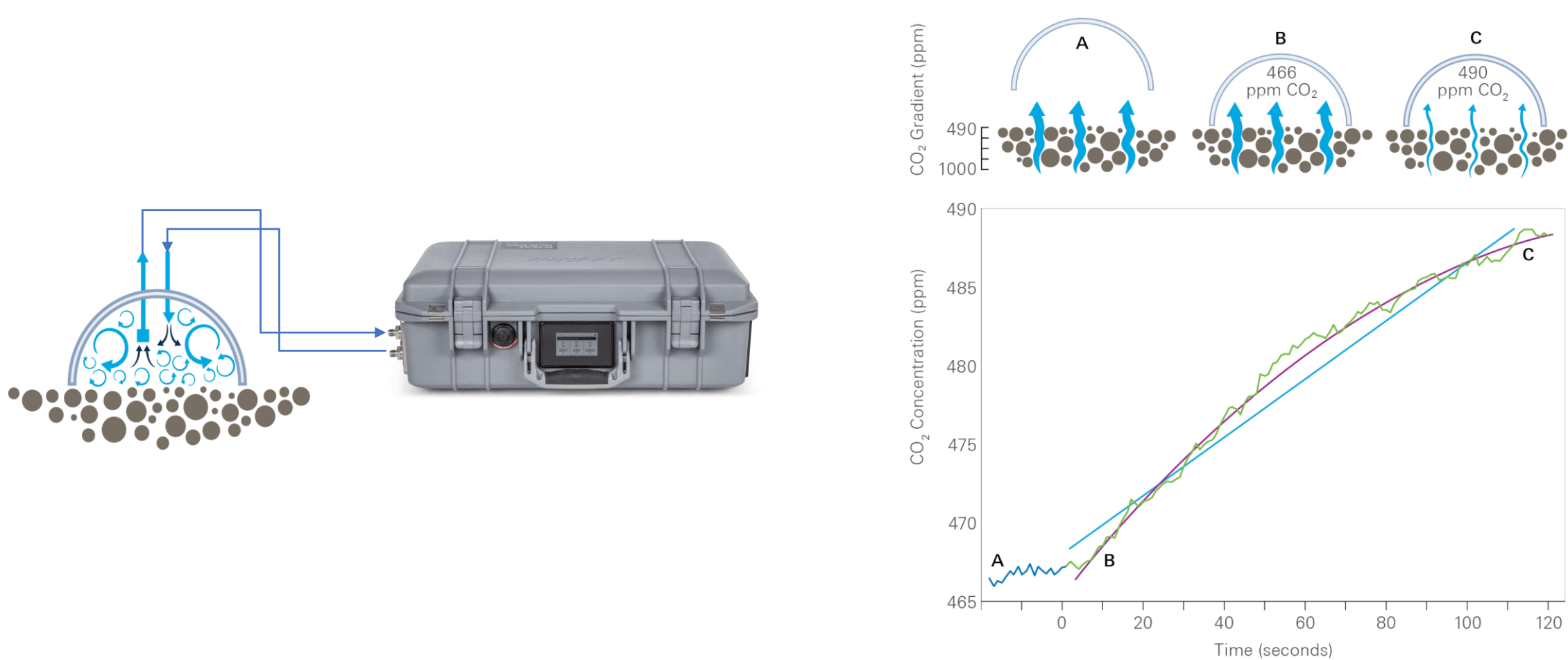


LI-7820 Specifications

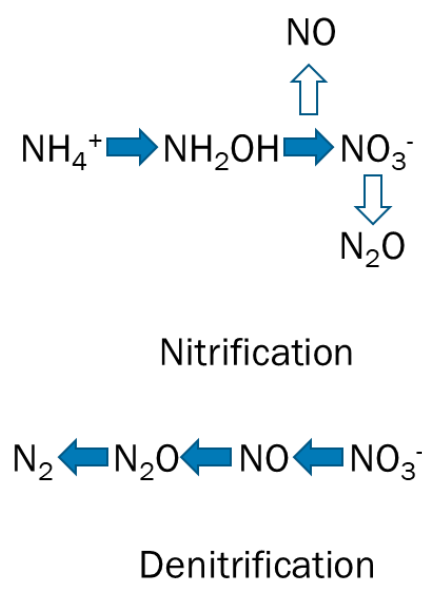
Specification	LI-7810	LI-7815	LI-7820
Gases measured	CH ₄ /CO ₂ /H ₂ O	CO ₂ /H ₂ O	N ₂ O/H ₂ O
Primary, high-precision analyte	CH ₄	CO ₂	N ₂ O
Concentration range	0-100 ppm	0-10,000 ppm	0-100 ppm
Precision (1σ, 1 second averaging)	0.6 ppb	0.1 ppm	0.4 ppb
Precision (1σ, 5 second averaging)	0.25 ppb	0.04 ppm	0.2 ppb
Drift (24 hours)	<1 ppb	<0.2 ppm	<1 ppb
Response time (T ₁₀ -T ₉₀)	<2 seconds	<2 seconds	<2 seconds



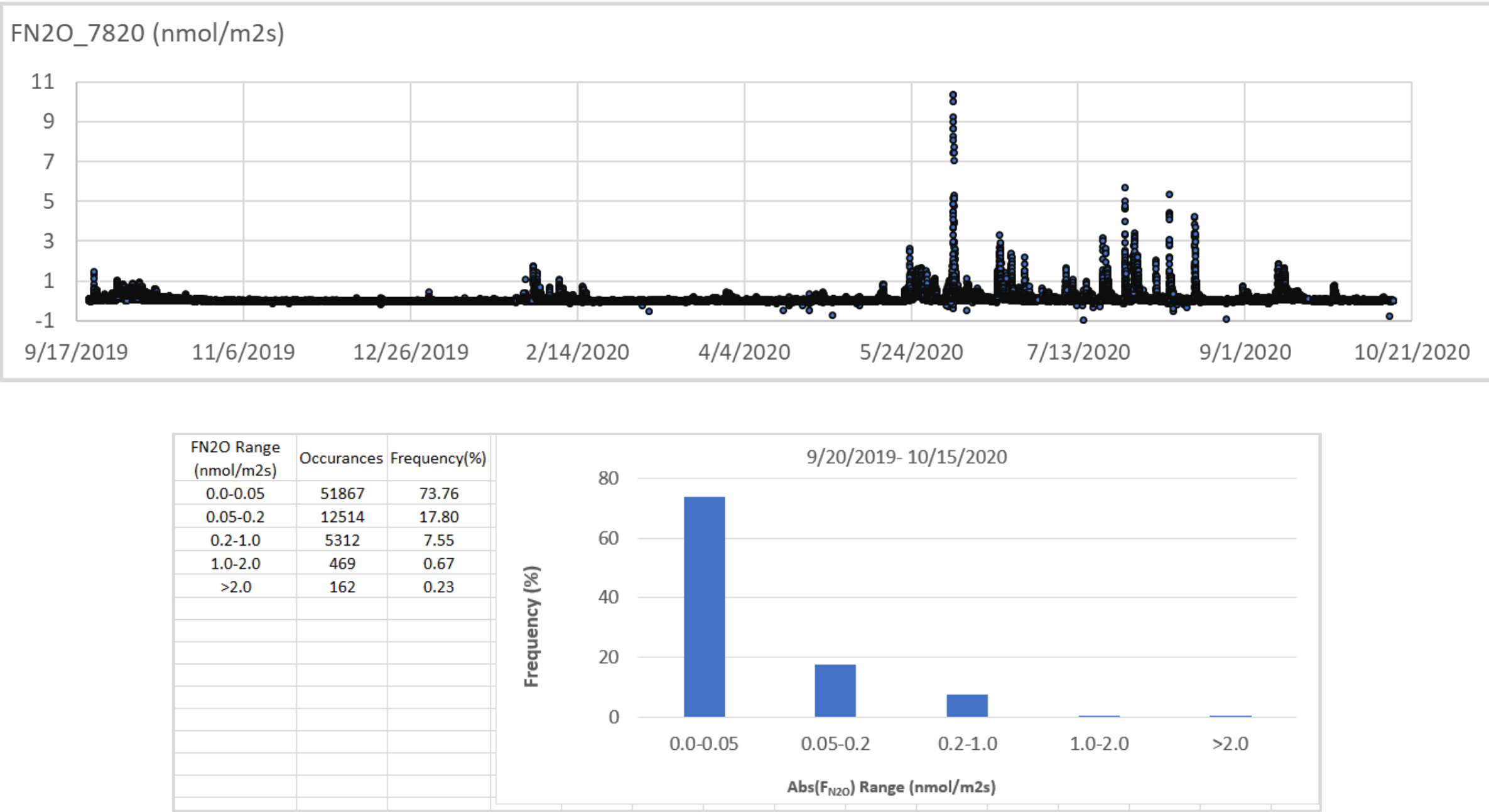
Soil Flux Chamber Measurements – Introduction



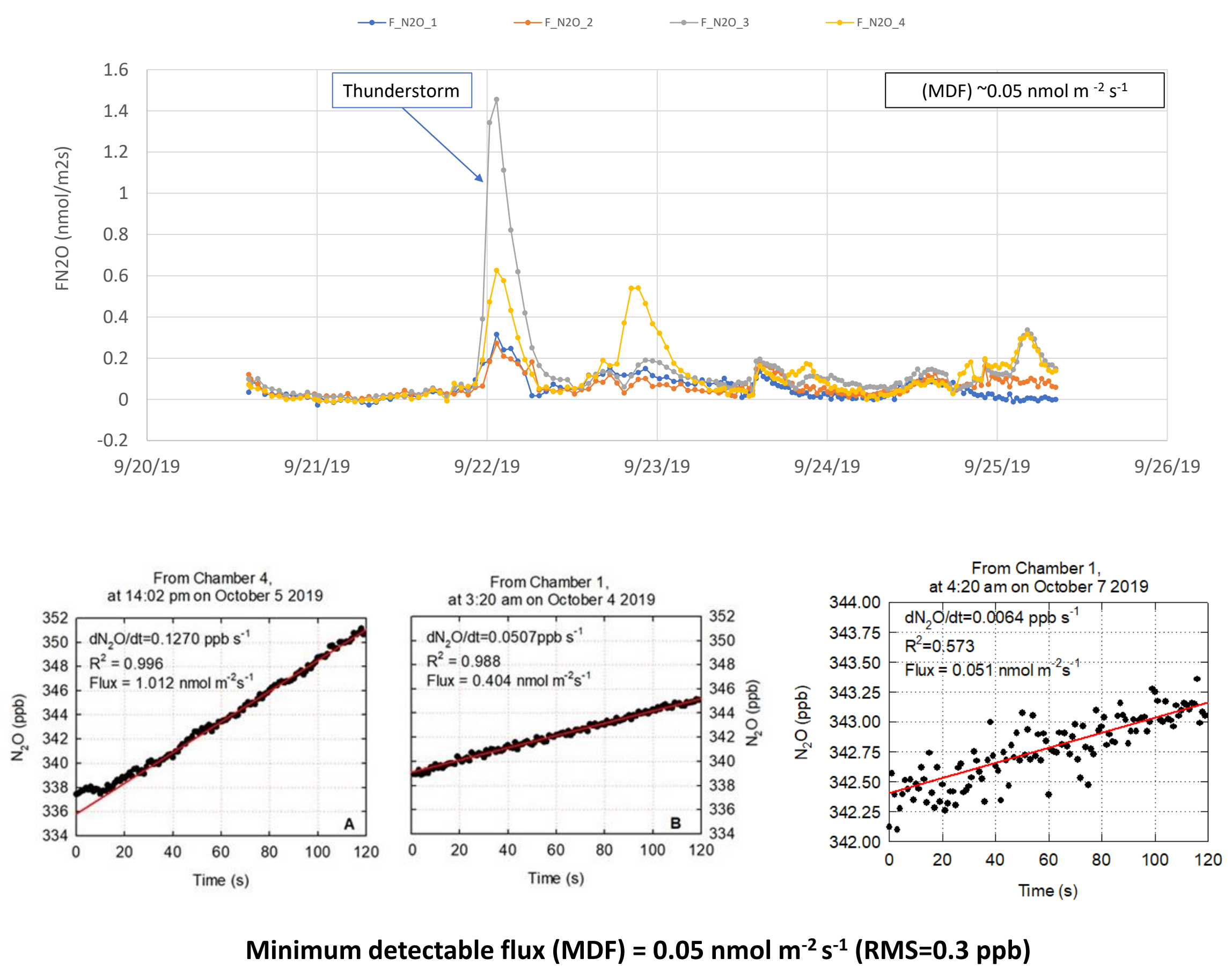
- N₂O is produced in soil by microbial activity
 - Denitrification
 - Nitrification
- Rate of production dependent on soil conditions
 - Temperature
 - Water content
 - Application of nitrogen-based fertilizer



LI-7820 Example Measurements (1-Year)



LI-7820 Example Measurements (1-Week)



Minimum detectable flux (MDF) = 0.05 nmol m⁻² s⁻¹ (RMS=0.3 ppb)