

# Eddy covariance system integration and operation

Zhongwei, Ningxia, China

July 2018

# Eddy Covariance Data/Workflow Pipeline

Raw Data  
Collection



Data  
Processing



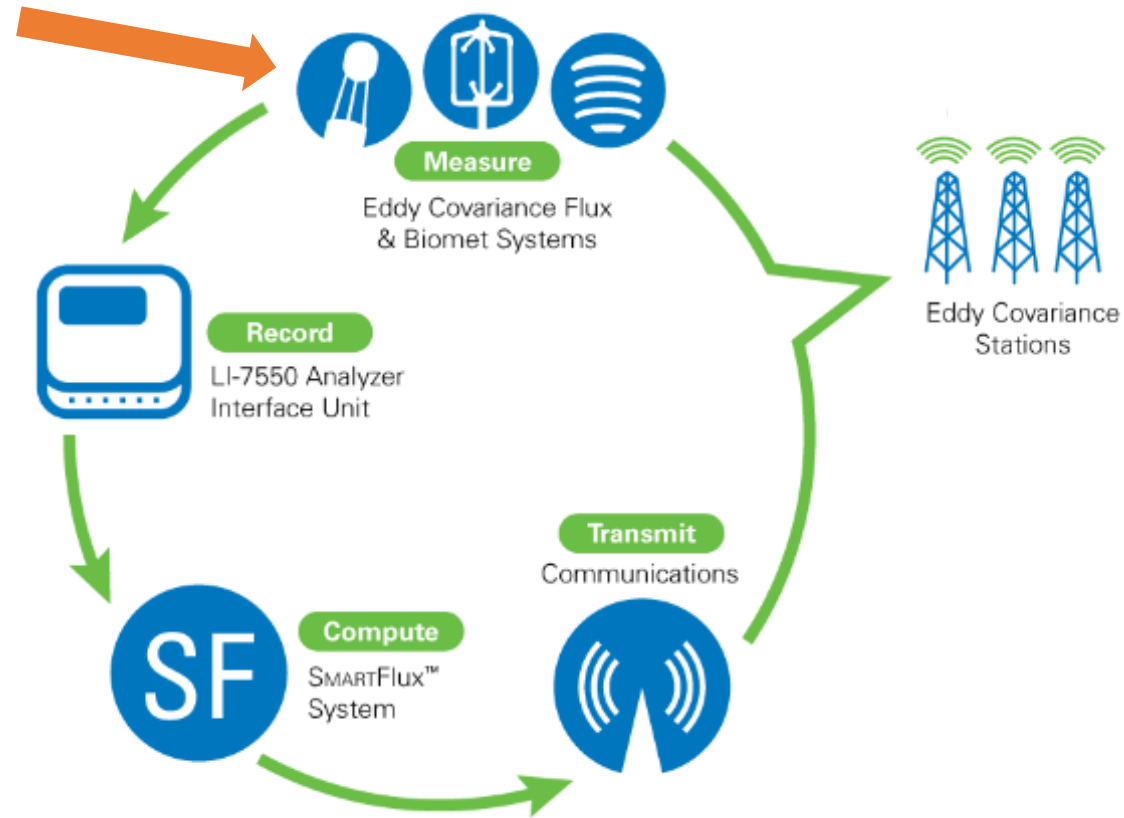
Post-Processing  
and Analysis



Publication

# Measurements and Computations

- LI-COR Analyzers used in 90% of Flux Sites around the world
- Now with new improvements



# The LI-COR Open-Path Analyzer

- LI-7500 → LI-7500A → LI-7500RS
- Engineering and manufacturing Gas Analyzers for **over 25 years**.
- Some LI-7500 analyzers have been deployed in the field for **15+ years**
- Strong scientific and engineering team designs for **best performance** (power, aerodynamics, etc)

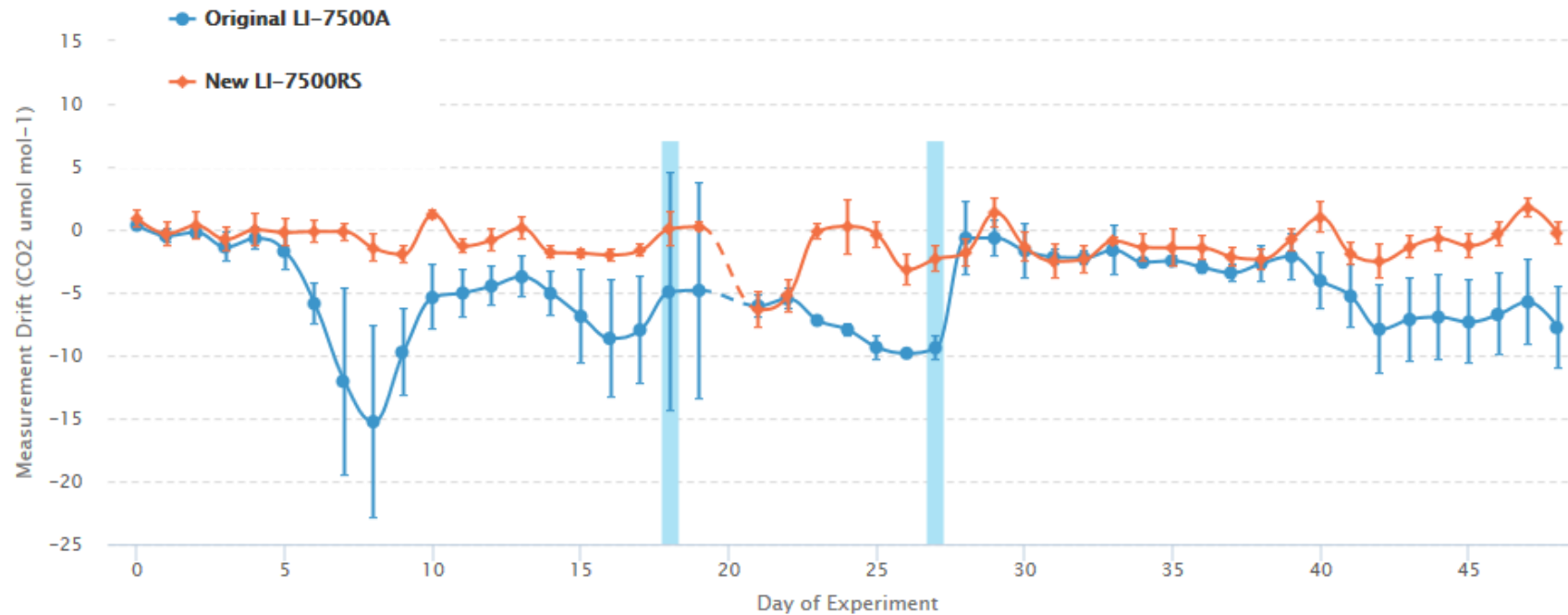


# New LI-7500DS: Highlights

- Retains new optical design from LI-7500RS
  - Gas Analyzer (head) form-factor is the same
  - More stable concentrations — even when not cleaned for weeks or months
  - Drift can be reduced by orders of magnitude
- New temperature controls for even better stability
- The SmartFlux 3 system becomes the core
- Eliminates LI-7550 Analyzer Interface Unit
- Lower power consumption.
- Improved temperature measurement with sensor embedded in the spar
- Calibration information stored in sensor head

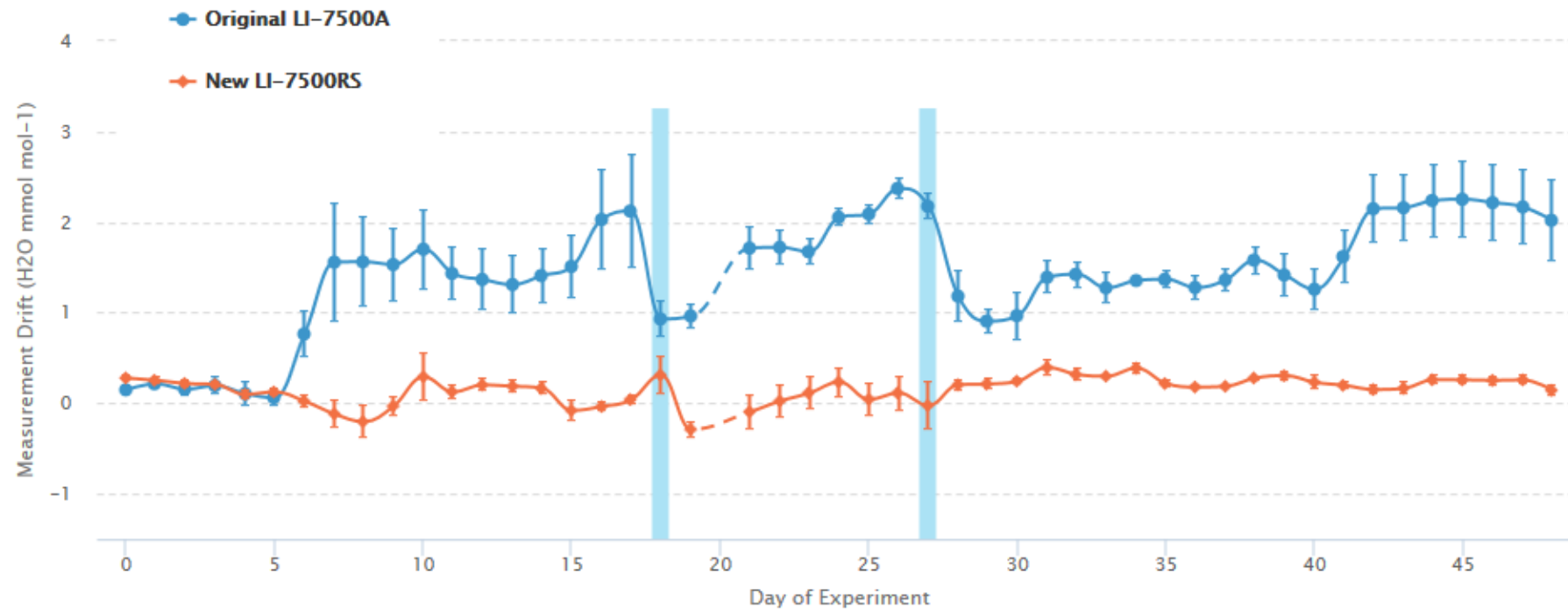


# Performance – CO<sub>2</sub>



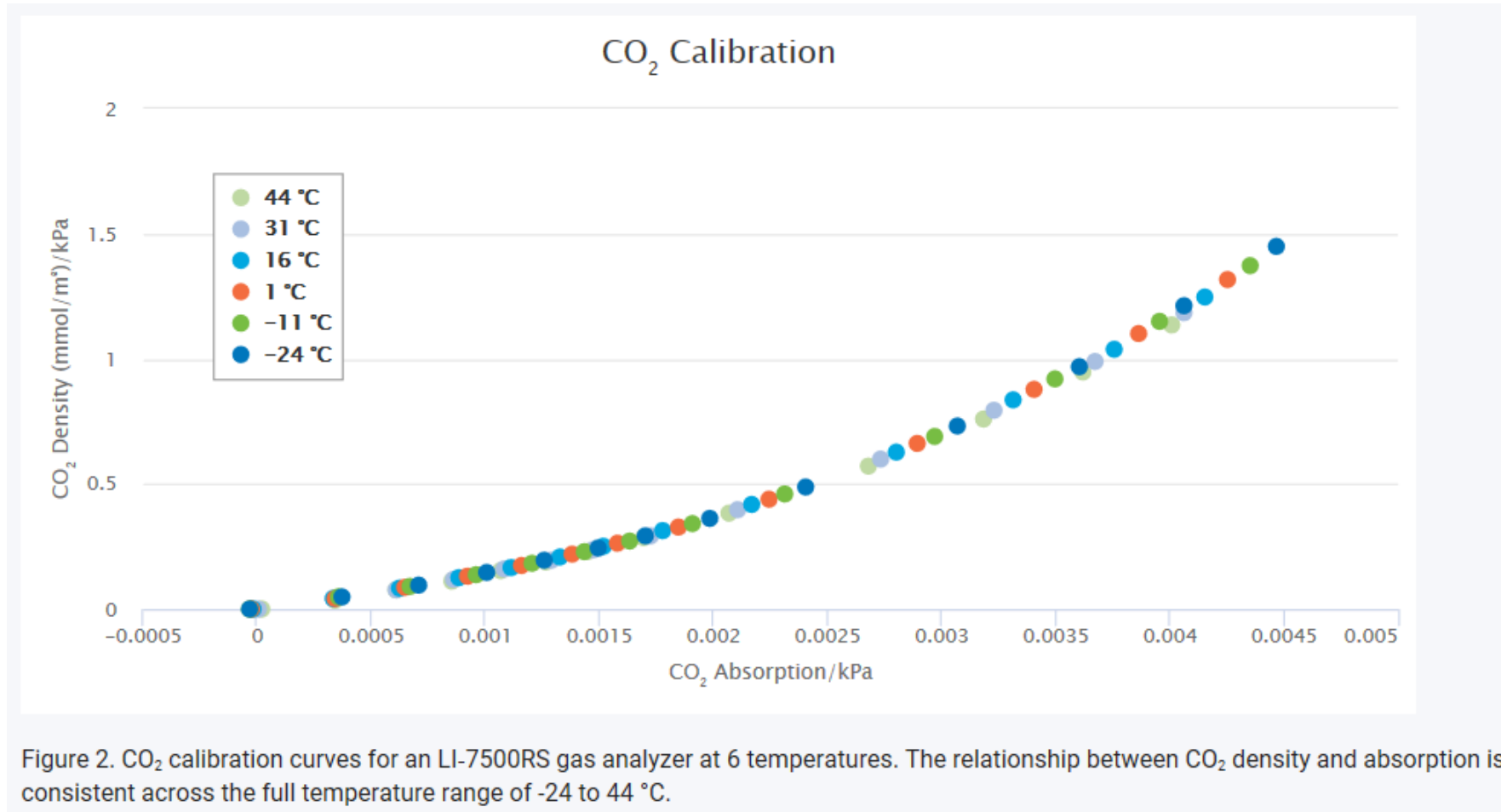
**Figure 1.** CO<sub>2</sub> measurements from three LI-7500RS analyzers and three LI-7500A analyzers (average and spread). The y-axis shows the deviation from a control reference. CO<sub>2</sub> measurements from the LI-7500RS analyzers drifted considerably less and had smaller instrument-to-instrument variability than those from the original LI-7500A models. Data show the typical improvement expected from the LI-7500RS analyzer.

# Performance – H<sub>2</sub>O



**Figure 2.** Water vapor measurements from three LI-7500RS analyzers and three LI-7500A analyzers (average and spread). The y-axis shows the deviation from a control reference. Measurements from the LI-7500RS analyzers drifted several times less, and had smaller instrument-to-instrument variability when compared with original LI-7500A models.

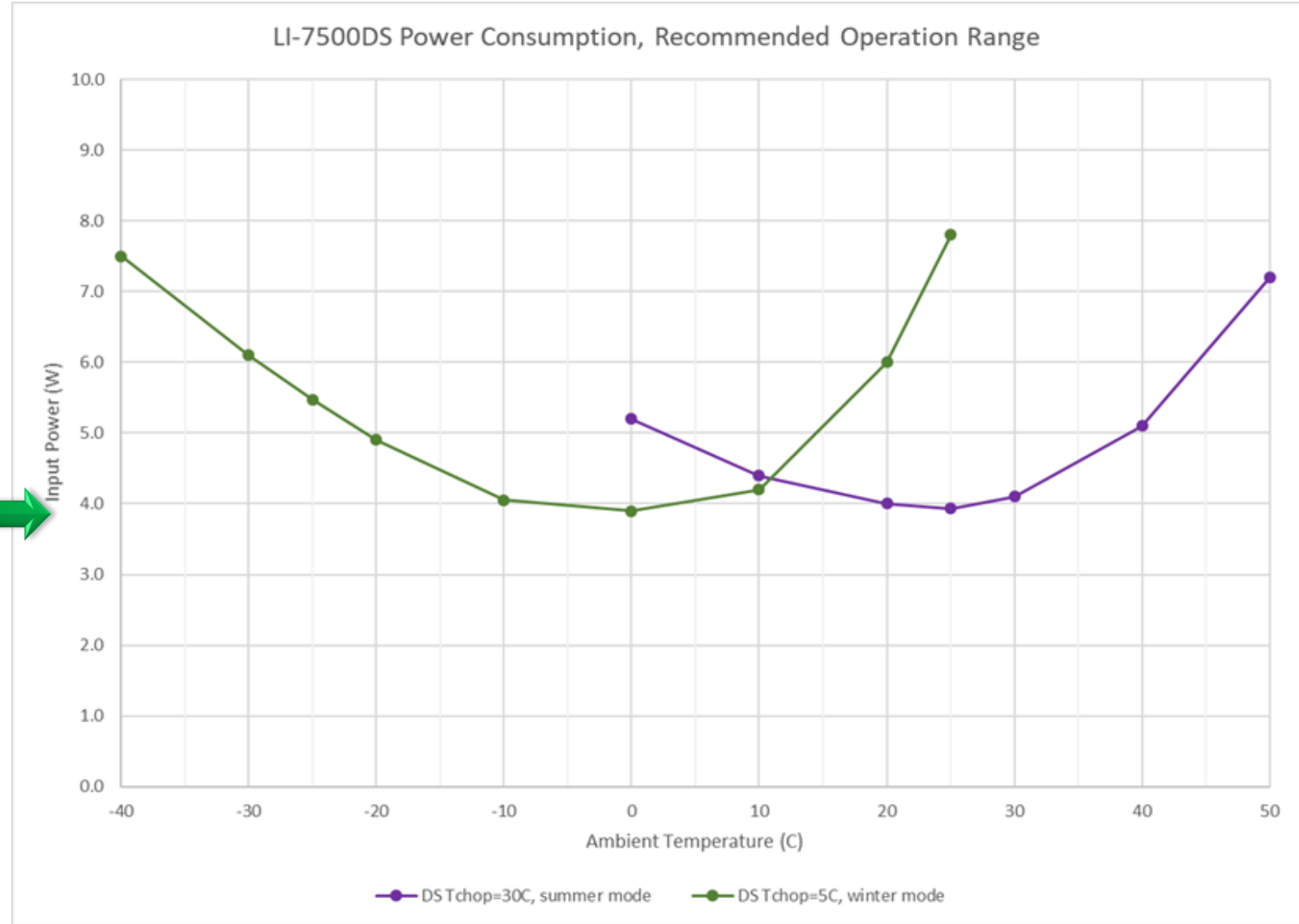
# Consistent Performance Across the Full Temperature Range





# Lower Power

- Now, operation is typically **4-5 watts**



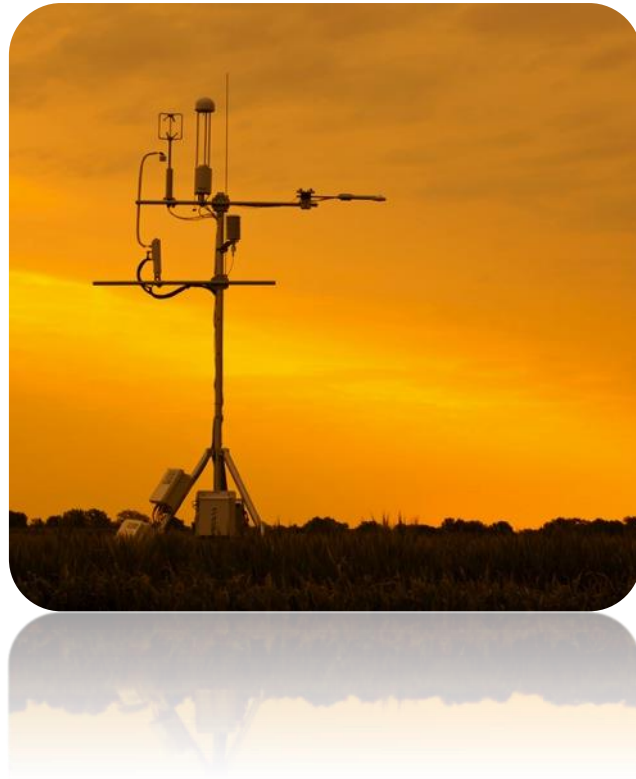
# Sonic Anemometers

LI-COR Systems integrate with:

- Gill, CSI, RM Young, Metek...
- Provide u, v, w, Tsonic, and diagnostics
- Digital (Serial) or Analog output

# Sensor Arrangement

- Acceptance angles, alignment, flow distortion and sensor separation



# Points to remember...

Many of the location requirements follow directly from the EC equations and are intended to satisfy the assumptions made during derivations:

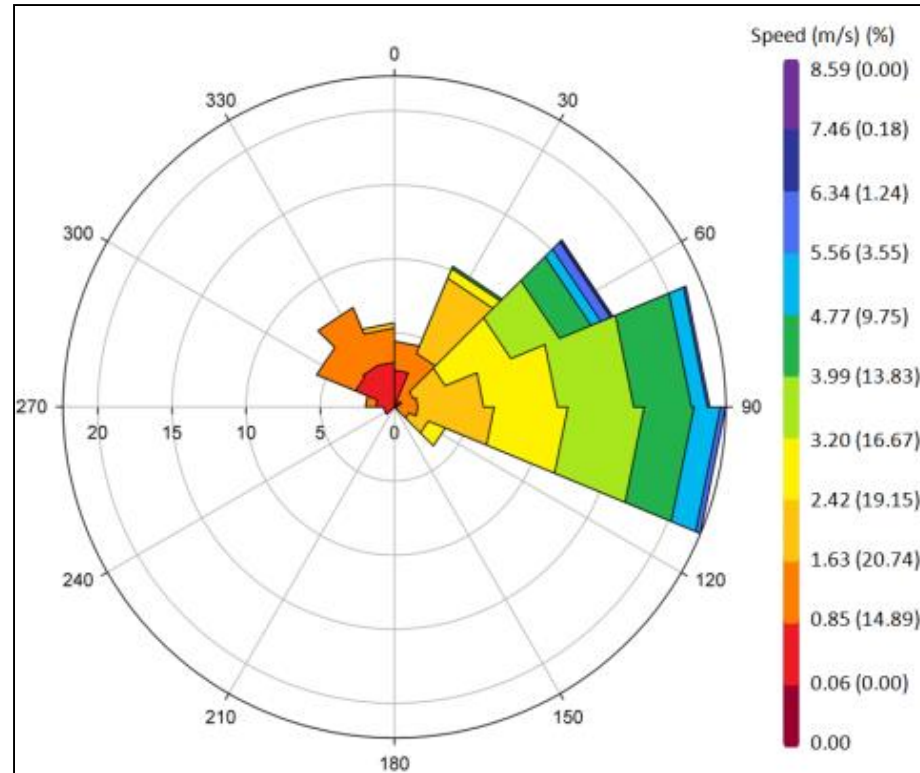
- Represent the ecosystem/area of interest
- Large enough: sufficient fetch/footprint
- Terrain is reasonably flat and uniform

# What is the prevailing wind direction?



# Determining prevailing wind direction

## Windrose



<http://mesonet.agron.iastate.edu/sites/locate.php>

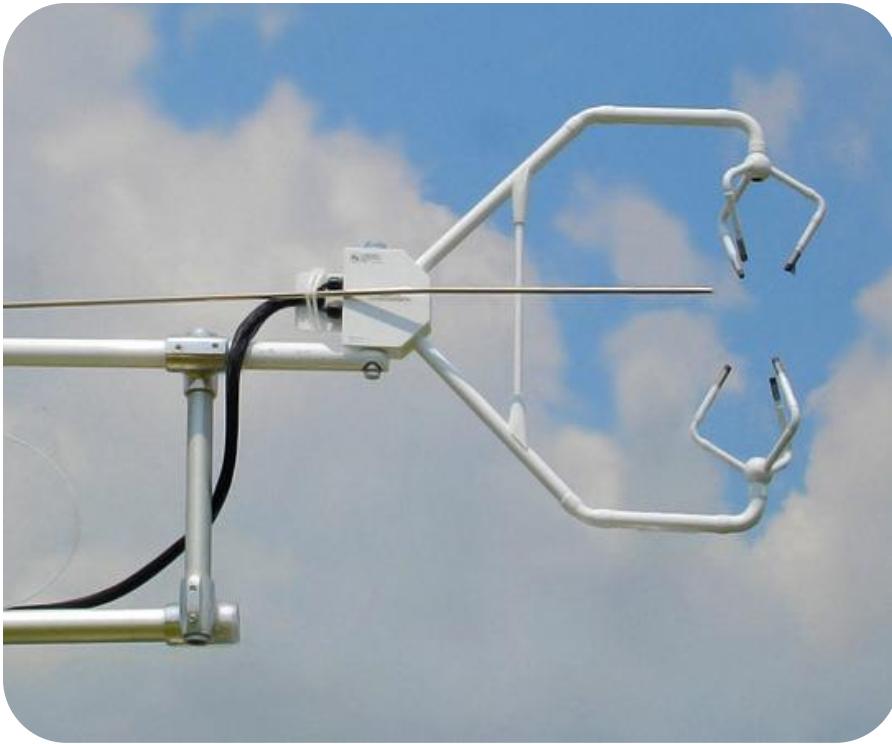
# Locating the tower...





# Sonic designs and acceptance angles

C-clamp



Omnidirectional

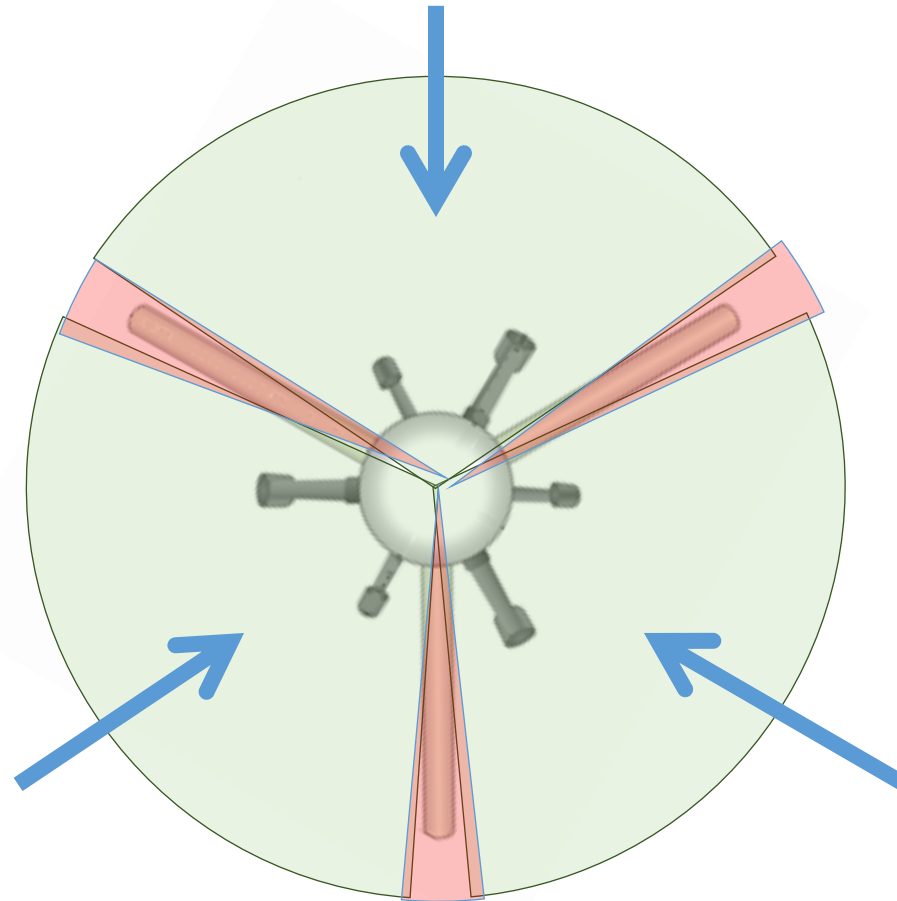




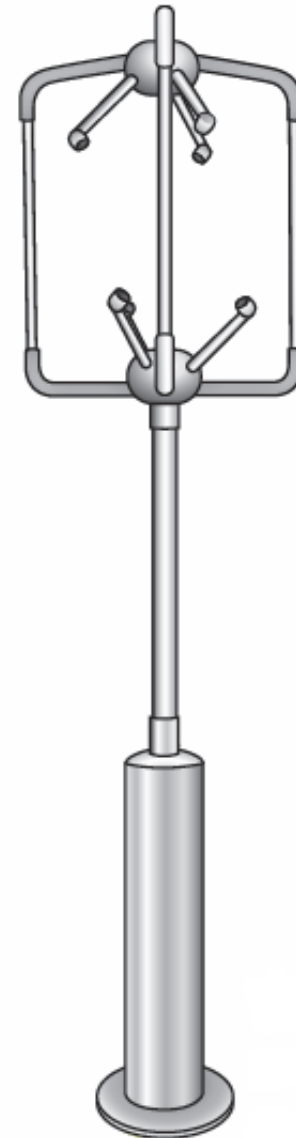
# Omni-directional alignment

360 degrees

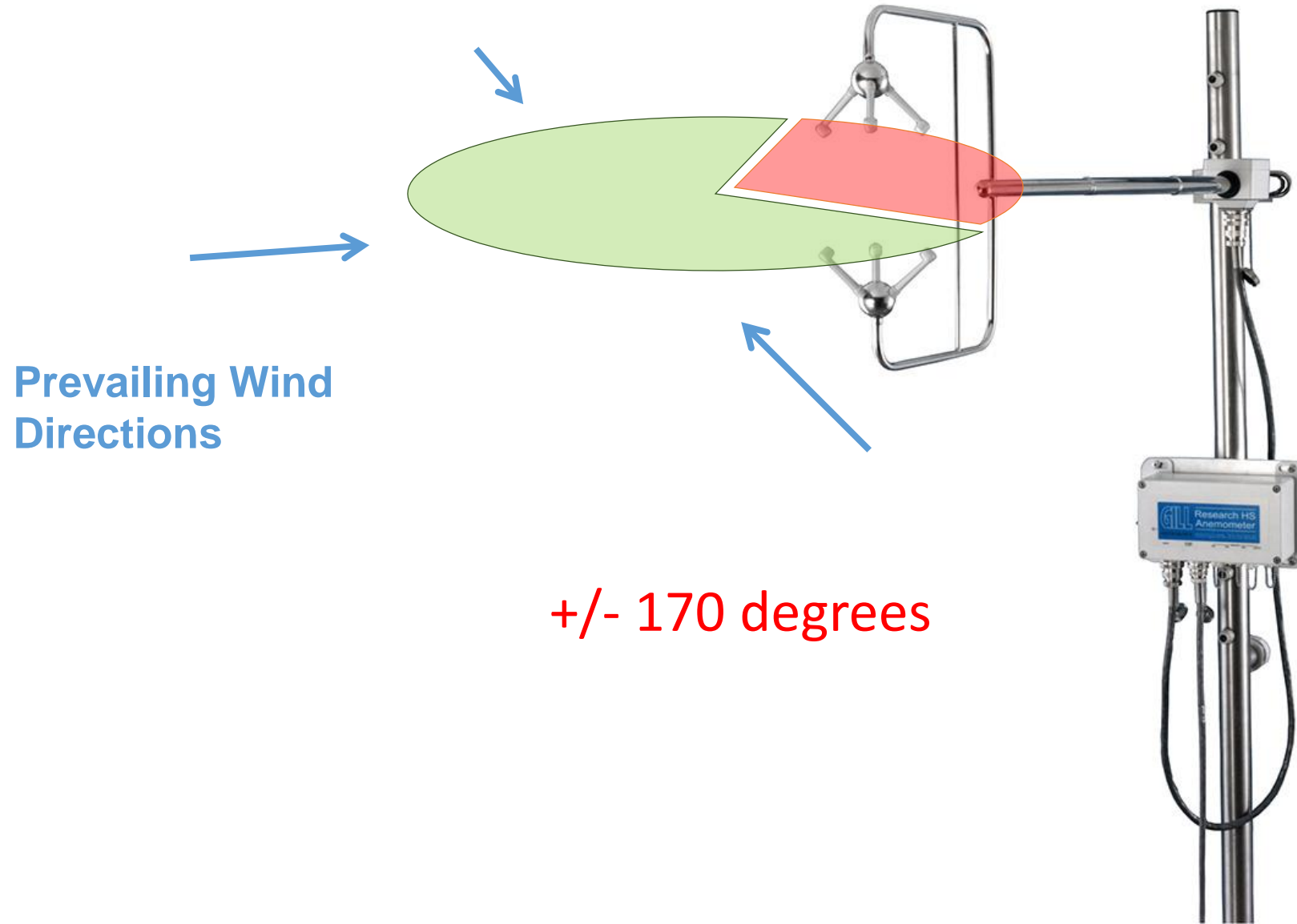
Prevailing Wind  
Directions



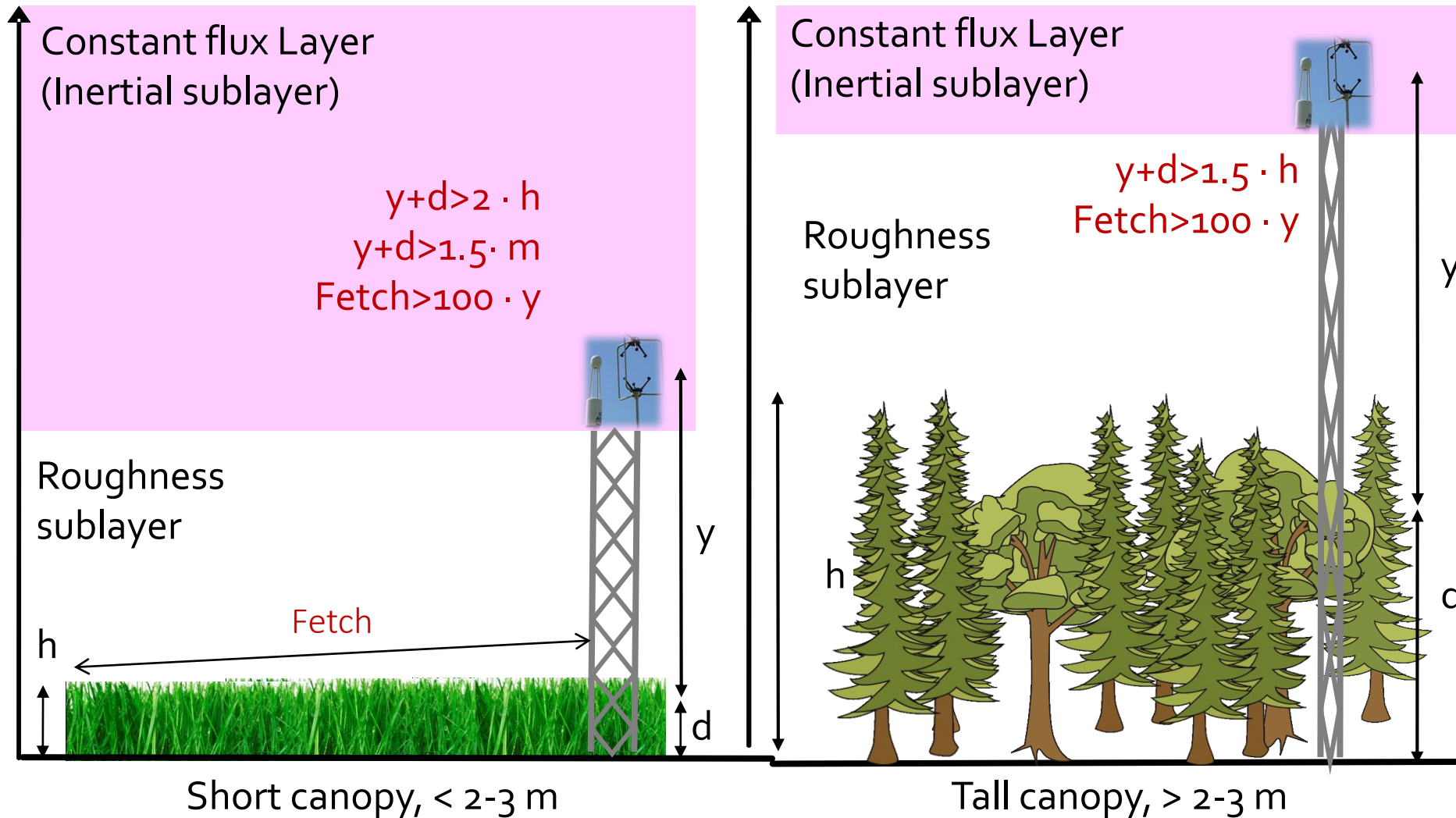
(+/-) 2-to-5 degrees



# C-Clamp alignment



# Points to remember...the 'rules-of-thumb'



# Sensor separation

- Physical separation between anemometer and analyzer should as small as possible, **but** should not be too close where the analyzer distorts flow through the sonic.



# Sensor separation

- Relative to the center point of the measurement volume
- Measured relative to the sonic





# Sensor separation

Horizontal:  
10 to 30 cm



# Sensor separation

## Vertical:

- 0 cm when close to the canopy/ground
- Scalar sensors lower than the sonic high above the canopy
- When sampling volume is large relative to sonic, ensure they overlap





Fittings and pipes are used to get appropriate separations





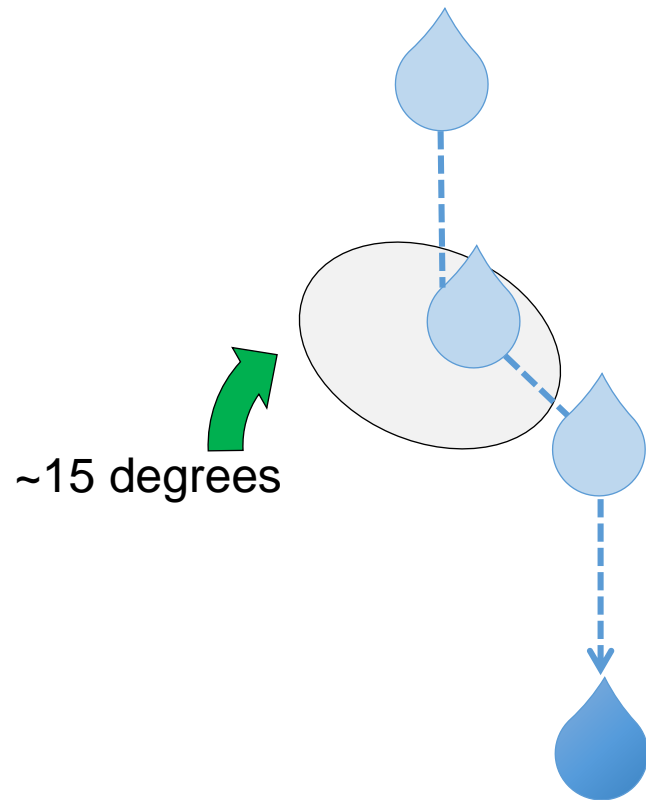
# Deploying the instruments

- Why are all the LI-7500 Analyzers at an angle?



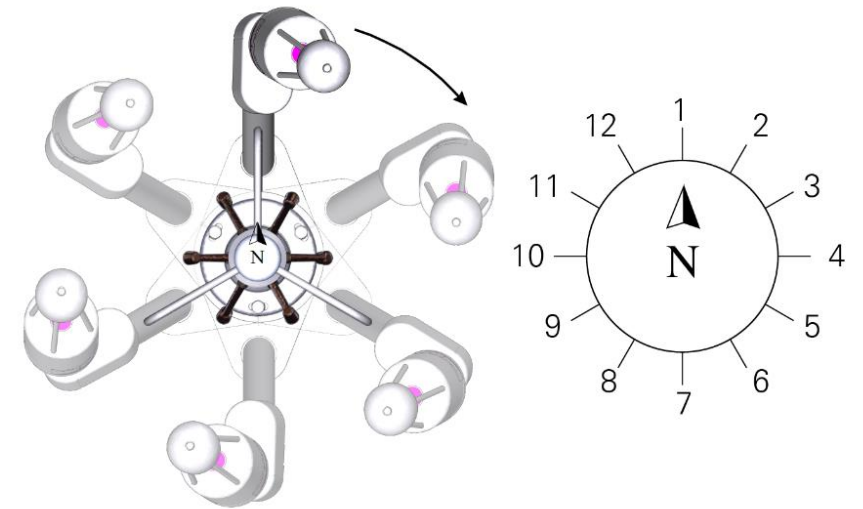
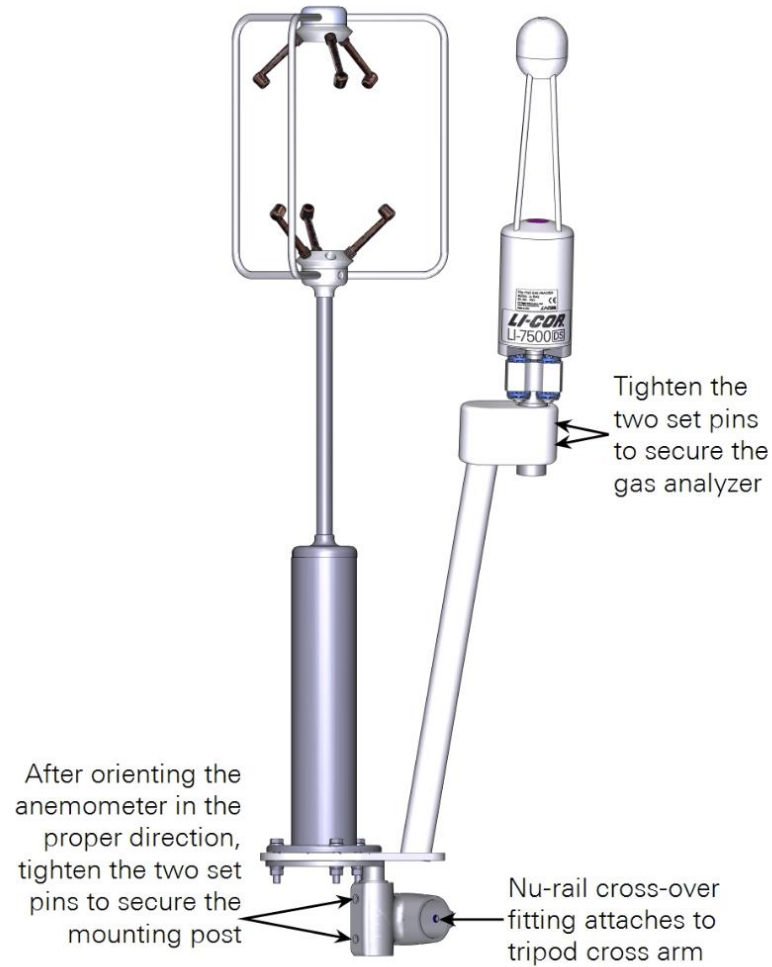
# Deploying the instruments

- Orienting the LI-7500RS



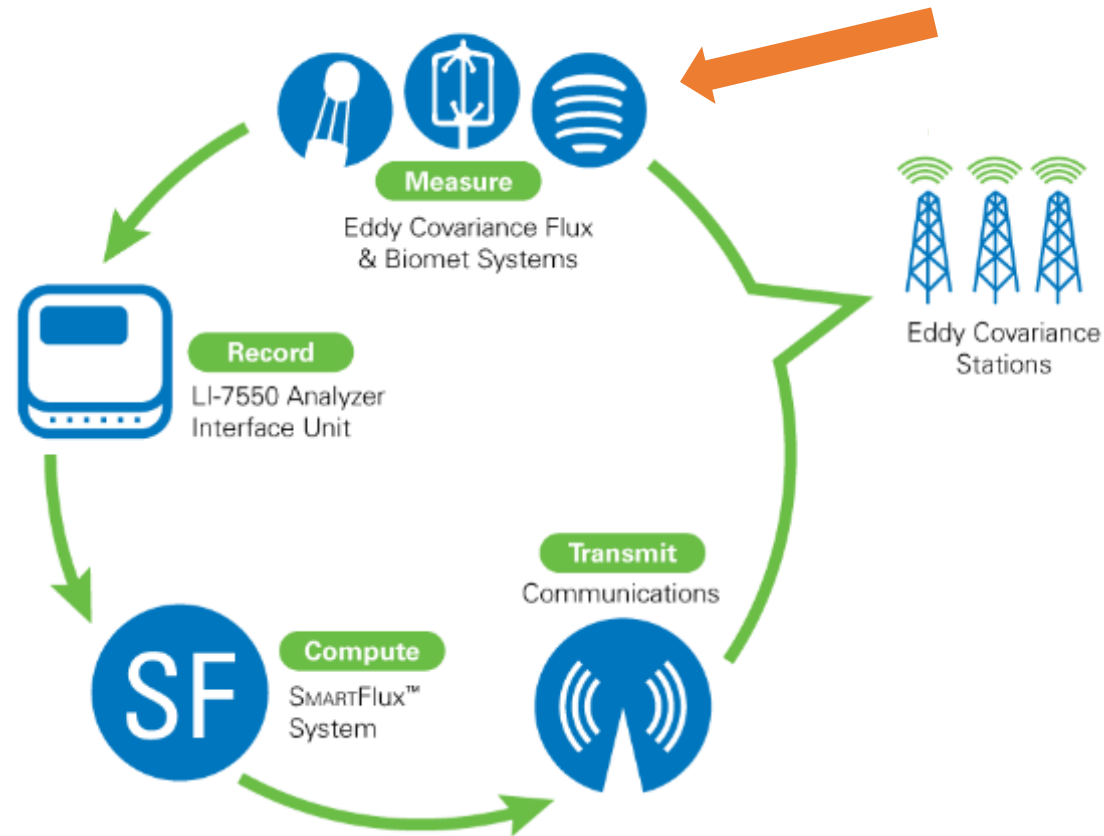
# New Mounting device

- Combined
- Omnidirectional
- Ease-of-use
- Flexibility



# Measurements and Computations

- Integration of Biomet data from Loggers



# Slow Sensors (Biomet)

- Several types of sensors from several manufacturers
- Provide Air Temperature, Relative Humidity, Radiation ....
- Output varies by sensor mostly analog some digital (SDI-12)

# Data Collecting and Processing Components

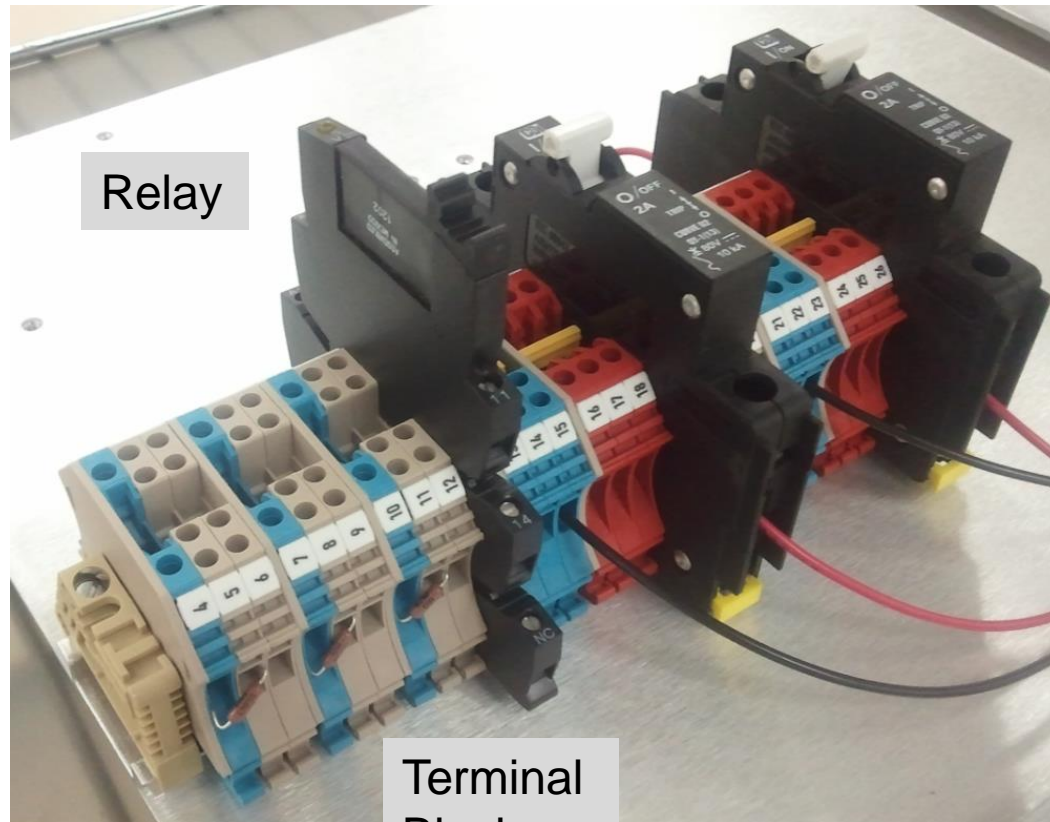
## Biomet Interface (Biomet Data loggers):

- Sutron - 9210
- CSI - CR1000, CR3000, CR6



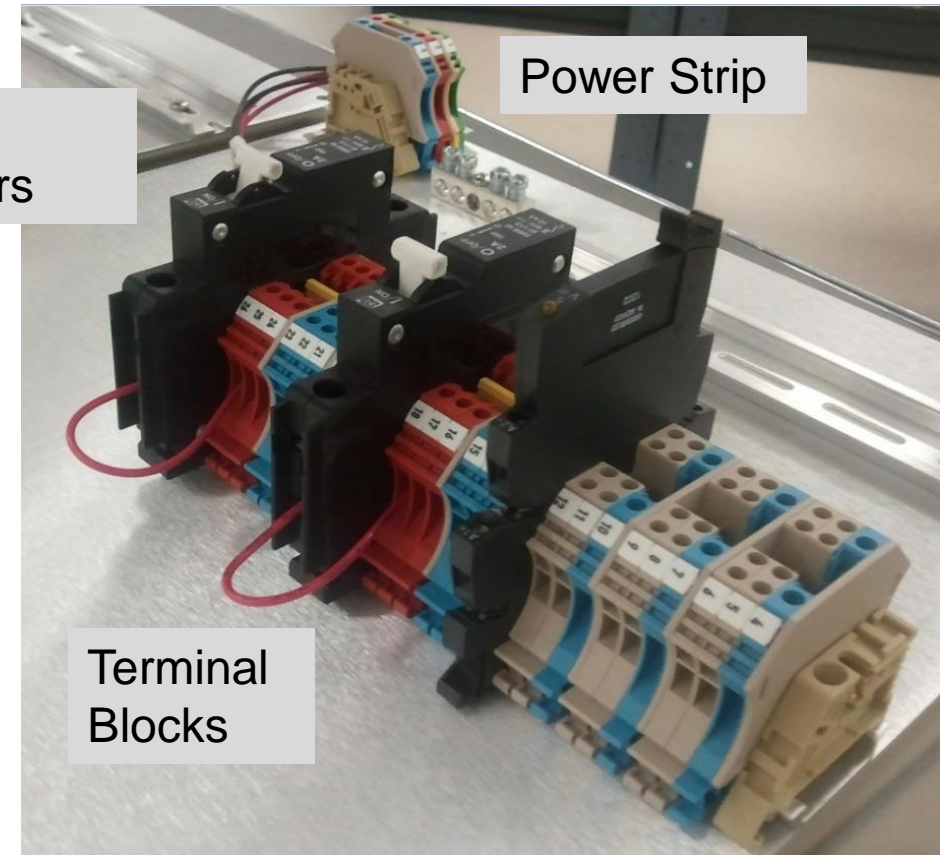


# Typical Components in Biomet Enclosure



Relay

Terminal  
Blocks



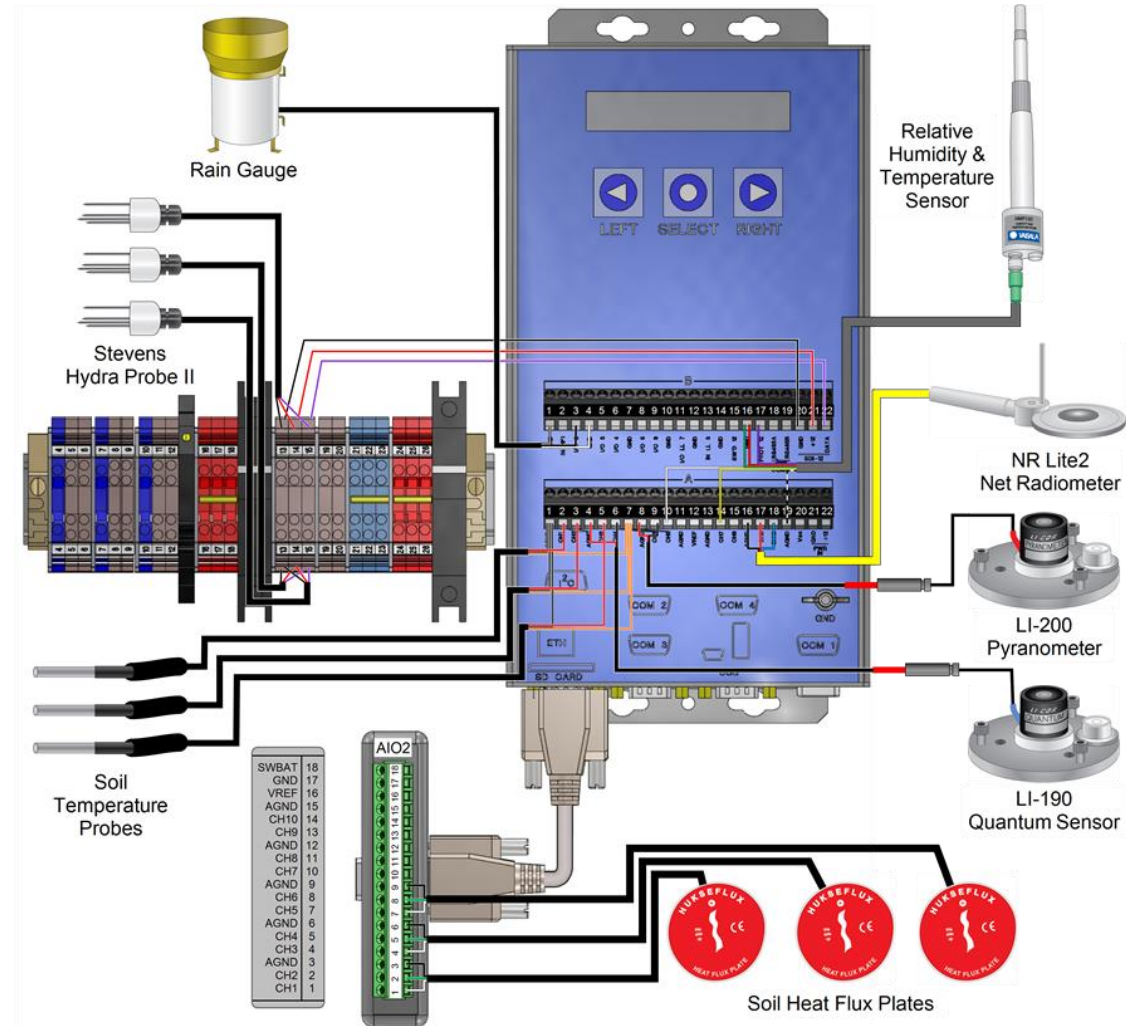
Power Strip

Circuit  
Breakers

Terminal  
Blocks

# Integrate the Biomet System

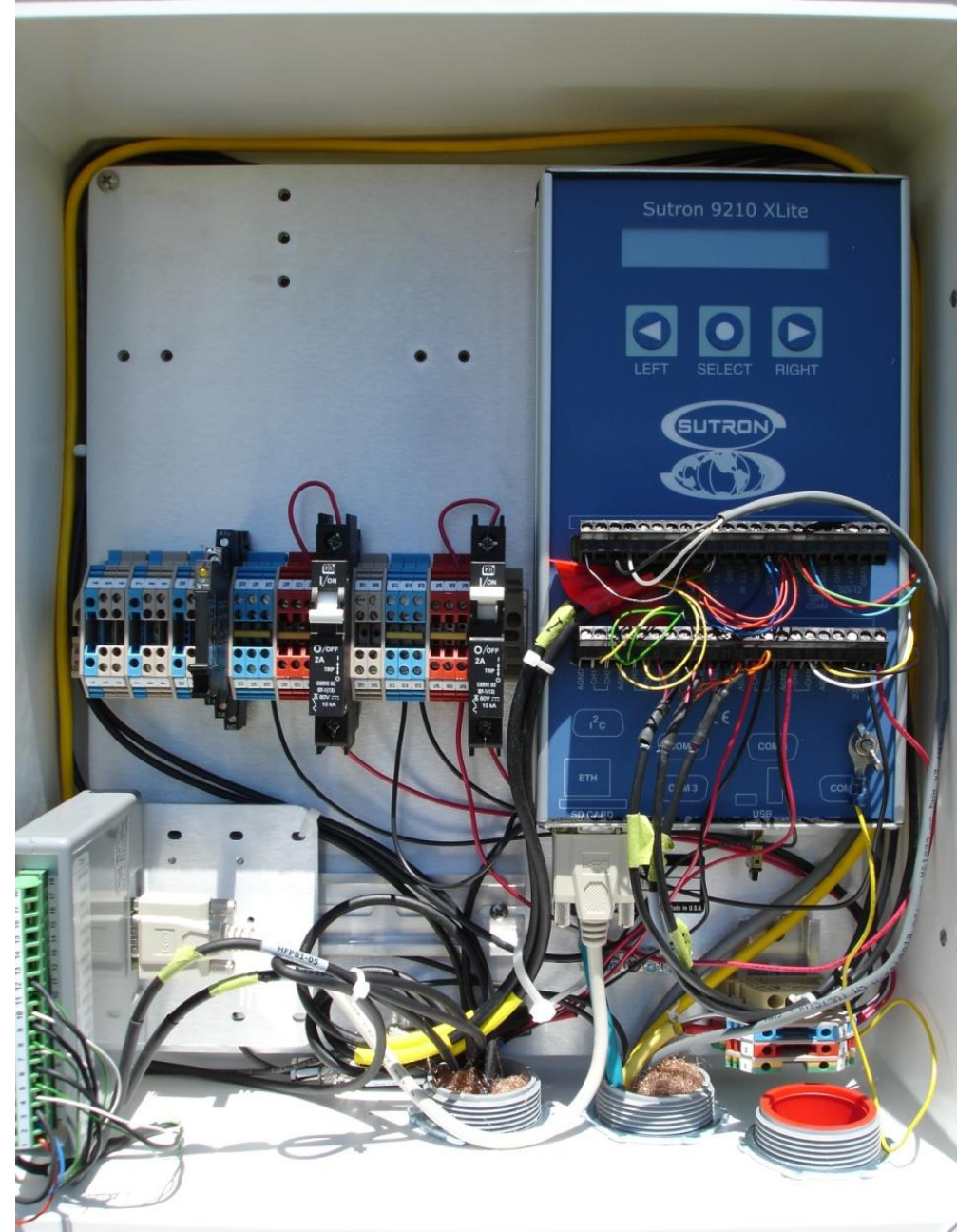
- Install the Sensors (as per Installation Guides) and connect them to the Logger.





# Typical Program

- Samples 18 analog channels and 1 digital channel
- Samples every 5 seconds
- Logs every minute
- Transmits data via Ethernet



# Biomet System Integration







- Biomet Sensors should be installed and integrated.
- Cable lengths (Tripod or Tower)
- The level of integration depends on the Biomet System.

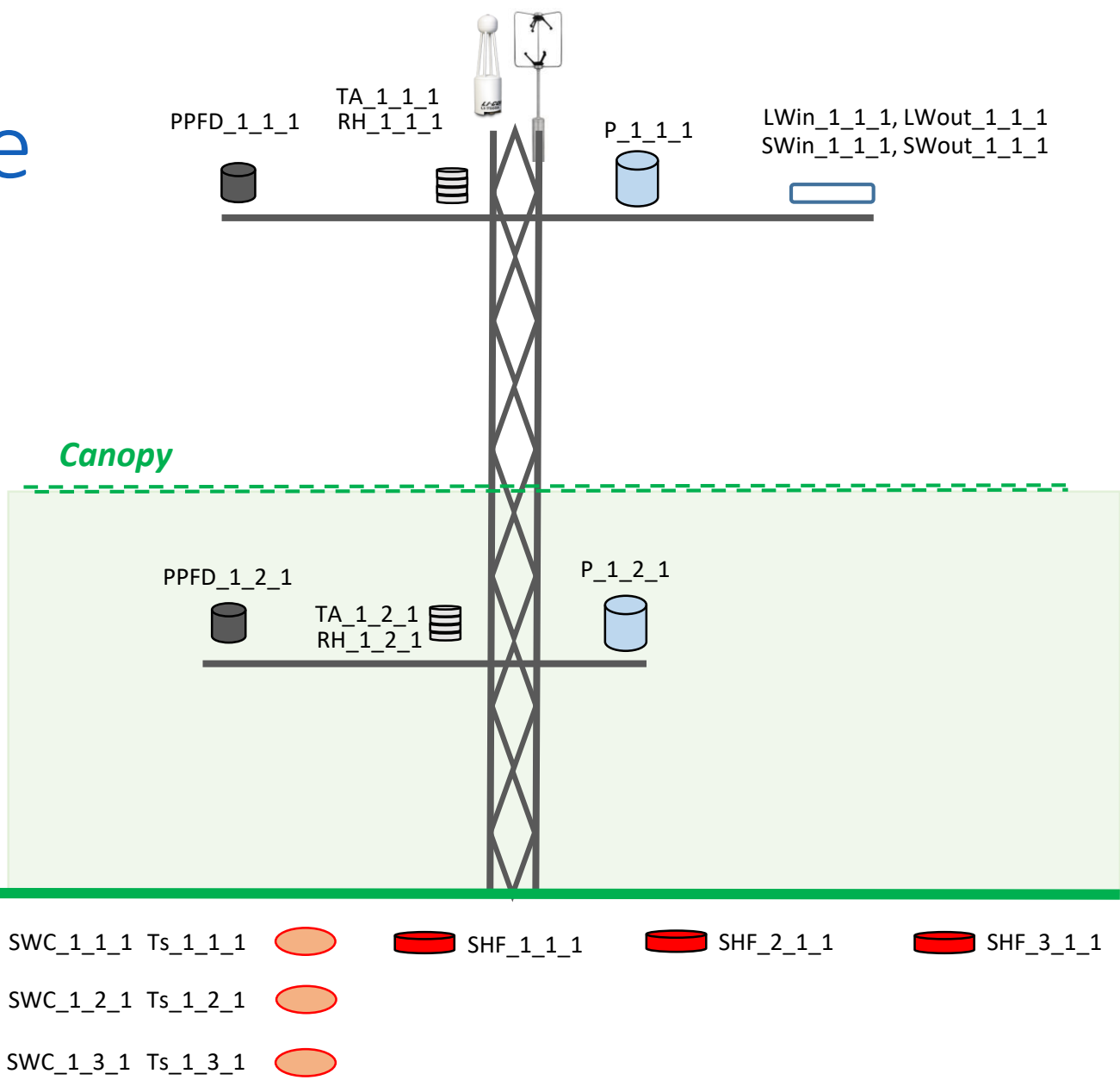


# Biomet Nomenclature

VariableName\_H\_V\_R



-  = PAR Quantum Sensor
-  = Air Temperature and Relative Humidity (Ta, RH)
-  = Total Precipitation
-  = 4-Component Net Radiometer
-  = Soil Moisture, Temperature, Salinity
-  = Soil Heat Flux (SHF)



# Integrating CSI Biomet

- CR1000, CR3000 require Ethernet interface NL-121
- Program must be compatible with EddyPro/LI-COR nomenclature
- <https://licor.boxenterprise.net/s/y4gseu1o899brj2gmjksgfdtw1h6w72y>

## Using Campbell Scientific® Dataloggers to Collect Biomet Sensor Data

### Contents:

Initial Steps	1
Configuring the network and permissions	1
Creating the Biomet data table	3
Creating EddyPro-compatible field names	3
Relating field names with sensor position	5
Using Biomet.dll with sensor packages	5
User-vehicle constants	8
Datalogger and sensor wiring	9

With the addition of the SmartFlow 1 System, LI-COR eddy covariance systems can now collect biomet data from the Campbell Scientific CR6, CR1000, or CR3000 dataloggers. Compatibility between the datalogger and the LI7550 has the following requirements:

- The logger needs to support an Ethernet interface with a static IP address on the same network as the LI7550.
- The data for output needs to be stored in a data table called Biomet, and
- The field names used in the data table need to follow the standardized format required by EddyPro.

### Initial Steps

#### 1. Install an Ethernet cable

For the datalogger to communicate with the eddy covariance (EC) system, it needs a physical network connection on the same network as the LI7550 and SmartFlow 1 with a unique assigned static IP address. The CR6 has a built-in Ethernet port used for networking. If using the CR1000 or CR3000, an additional hardware component will be needed to connect the datalogger (e.g., NL113, NL114, or NL121 Ethernet Interface).

#### 2. Sync Clocks

When the EC system polls the datalogger for sensor data it can also set the datalogger's clock to match the time of the rest of the system. Enable this feature in the LI7500RS or LI7500RS software. As the main dashboard window, click Site Setup > Biomet, and check the box seen



### Configuring the network and permissions

1. Connect the datalogger to power and to the computer using its RS-232 connection.
2. Launch Device Config Utility from LoggerNet's Utilities menu.
3. Select the datalogger type under Datalogger and the port it is connected to under Communication Port. Click the button to bring up a list of available serial ports.

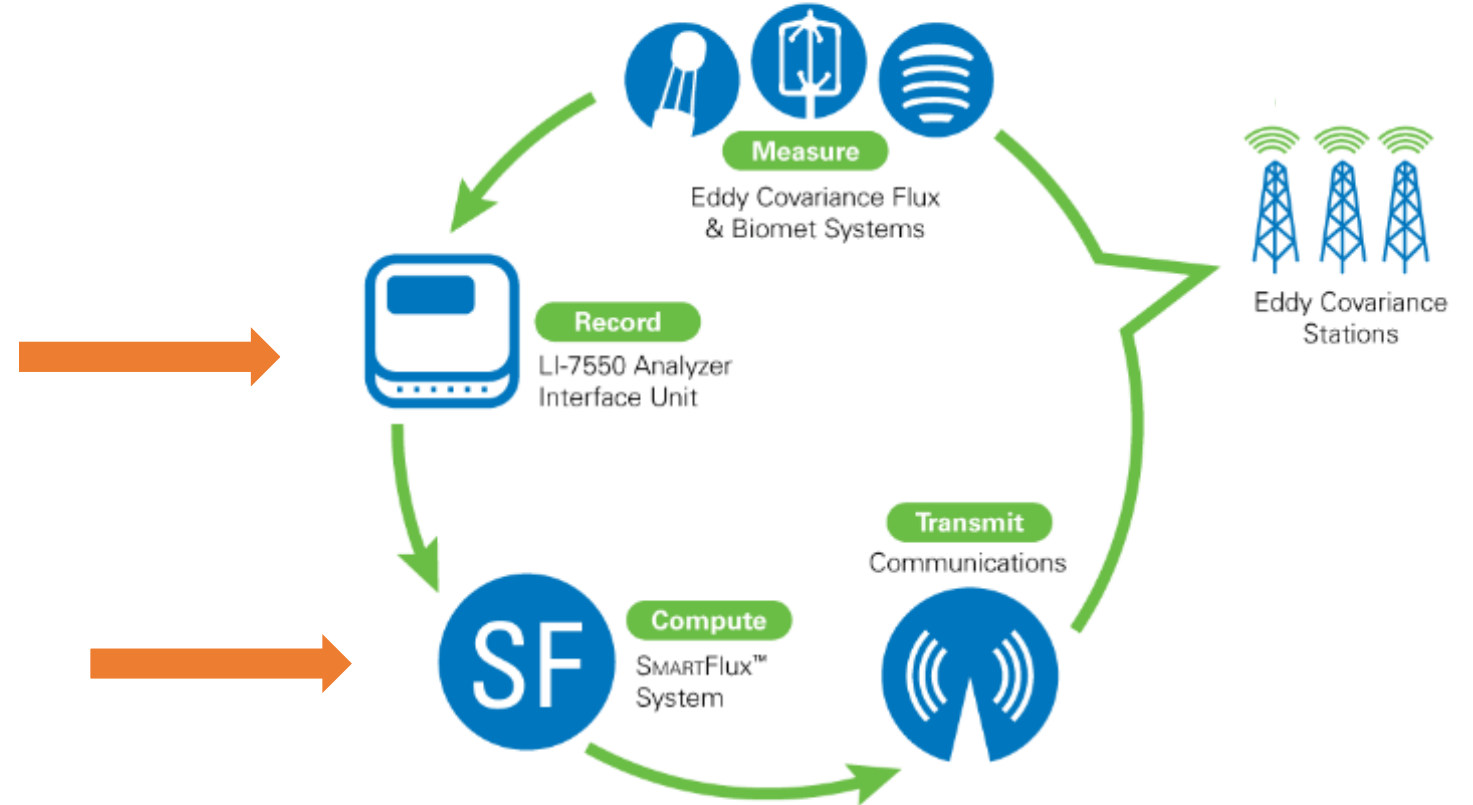


4. Click Connect and then choose Bypass at the pop-up window.



# Measurements and Computations

- Recording the data
- SmartFlux for automated, on-site, real-time, fully-processed flux computations (with EddyPro)



# Data Collecting and Processing Components

## LI-7550 Analyzer Interface Unit

- Data integration and logging
  - 16 GB USB drive
  - .ghg files
- Embedded software
  - **GHG** embedded



# Data management

- EC systems generate lots of data
  - 10 Hz sampling
  - 36000 records of raw data per hour → 864,000 per day →  $3 \times 10^8$  per year!



# EddyPro Data Processing software..

# eddyPRO®

Eddy Covariance Processing Software | Version 4.1

Powerful. Flexible. Intuitive.

Simple, modern interface with tips and guiding messages gets you to corrected fluxes quicker.

Planar Fit Settings

If you already ran EddyPro with the Planar Fit option for this dataset, you probably have a file named "eddypro\_planarfit.txt" in the results folder. You may use that file and speed up the data processing.

☐ Planar fit file available:

☒ Planar fit file not available:

Start: 1 Jan 2012  
End: 16 Apr 2012  
Minimum number of elements per sector: Not set  
Maximum mean vertical wind component: Not set  
Minimum mean horizontal wind component: Not set  
If planar fit calculations fail for a sector: Use closest valid sector, clockwise

Configure wind sectors

	Degrees
4	30.0 [°]
5	30.0 [°]
6	30.0 [°]
7	30.0 [°]
8	30.0 [°]
9	30.0 [°]
10	30.0 [°]
11	30.0 [°]
12	30.0 [°]

Set equally spaced

North offset first sector: 0.0 [°]

Ok

EddyPro is available for free download from LI-COR Biosciences:

[Download](#)

Version 4.1.0 | Released 11/16/2012

► Over 2000 downloads in 120 countries.

[EddyPro Help](#) [View EddyPro Help](#) ?

[EddyPro Forum](#) Visit the EddyPro section on the LI-COR Environmental Forum

[Sample Data Files](#) Download example data files

EddyPro® is a powerful software application for processing eddy covariance data. It computes fluxes of momentum, carbon dioxide, water vapor, methane, and other trace gases with the eddy covariance method. In Express Mode, EddyPro processes data with commonly used default settings, requiring minimal user configuration. In Advanced Mode, it provides state-of-the-art choices for researchers who need control over data processing procedures. EddyPro is optimized to process GHG\* eddy covariance data files logged by LI-COR analyzers.

*EddyPro is an open source software application developed, maintained and supported by LI-COR Biosciences. It originates from ECO2S, the Eddy COvariance COmmunity Software project, which was developed as part of the Infrastructure for Measurement of the European Carbon Cycle (IMECC-EU) research project. We gratefully acknowledge the IMECC consortium, the ECO2S development team, the University of Tuscia (Italy) and scientists around the world who assisted with development and testing of the*



# EddyPro<sup>®</sup> Highlights

- Over 5,500 downloads in 176 countries
- Flux networks have adapted EddyPro<sup>®</sup> as a standard software for data processing
- Available for free download from LI-COR [www.licor.com/eddypro](http://www.licor.com/eddypro)

# Available Options in EddyPro<sup>®</sup>

## *Data Processing Options in EddyPro (Express Mode selections in italics)*

- Axis rotation for sonic anemometer tilt correction
  - *Double rotation*
  - Triple rotation
  - Sector-wise planar fit (Wilczak et al., 2001)
  - Sector-wise planar fit with no velocity bias (van Dijk et al., 2004)
- Detrending of raw time series
  - *Block averaging*
  - Linear detrending
  - Running mean
  - Exponential running mean
- Compensation of time lag between sonic anemometer and gas analyzer measurements
  - *Automatic time lag optimization (optionally as a function of RH for H<sub>2</sub>O)*
  - *Maximum covariance with default (circular correlation)*
  - Maximum covariance without default
  - Constant
  - None (option to not apply compensation)
- Statistical tests for raw time series data (Vickers and Mahrt, 1997)
- Compensation for air density fluctuations
  - *Webb et al., 1980 (open path) / Ibrom et al., 2007a (closed path)*
  - Use (or convert to) mixing ratio (Burba et al., 2012)
  - Optional off-season upatake correction for LI-7500 (Burba et al., 2008)
  - None (option to not apply compensation)
- Correction for frequency response (attenuation)
  - *Analytic high-pass filtering correction (Moncrieff et al., 2004)*
  - Low-pass filtering, select and configure:
    - *Moncrieff et al. (1997)*
    - Horst (1997)
    - Ibrom et al. (2007b)
    - Horst and Lenschow (2009)
    - Fratini et. al. (2012)
- Quality control tests for fluxes according to Foken et al. (2004)
  - *Flagging according to Carbo Europe standard (Mauder and Foken, 2004)*
  - Flagging according to Foken (2003)
  - Flagging after Göckede et al. (2004)

# Available Options in EddyPro® - continued

- Statistical tests for raw time series data (Vickers and Mahrt, 1997)
  - *Spike count/removal*
  - *Amplitude resolution*
  - *Dropouts*
  - *Absolute limits*
  - *Skewness and kurtosis*
  - *Discontinuities*
  - *Time lags*
  - *Angle of attack*
  - *Steadiness of horizontal wind*
  - *Individually selectable and customizable*
- Available outputs
  - *Full (rich) output with fluxes, quality flags and much more (standard format or available results only)*
  - *Ameriflux format*
  - *GHG Europe format*
  - *Raw data statistics*
  - *Full length spectra and co-spectra*
  - *Binned spectra and co-spectra*
  - *Binned ogives*
  - *Ensemble averaged spectra*
  - *Ensemble averaged cospectra, fitted models and ideal (Kaimal) cospectra*
  - *Details of steady state and turbulence tests*
  - *Raw data time series after each statistical tests/correction*
- Flagging after Göckede et al. (2004)
- Random uncertainty estimation
  - Mann & Lenschow (1994)
  - Finkelstein and Sims (2001)
- Flux footprint estimation
  - *Kljun et al. (2004)*
  - Kormann and Meixner (2001)
  - Hsieh et al. (2000)
- Other options applied in both Express and/or Advanced Mode include:
  - *Sonic temperature correction for humidity following van Dijk et al. (2004)*
  - *Spectroscopic correction for LI-7700 following McDermitt et al. (2011)*
  - *Angle of attack corrections for Gill anemometers following Nakai et al. (2006)*
  - *Angle of attack corrections for Gill anemometers following Nakai and Shimoyama (2012)*
  - *Inclusion of biomet data for improved flux computation/correction*

# Data Collecting and Processing Components

SmartFlux



SmartFlux 2 and 3



# The SmartFlux System

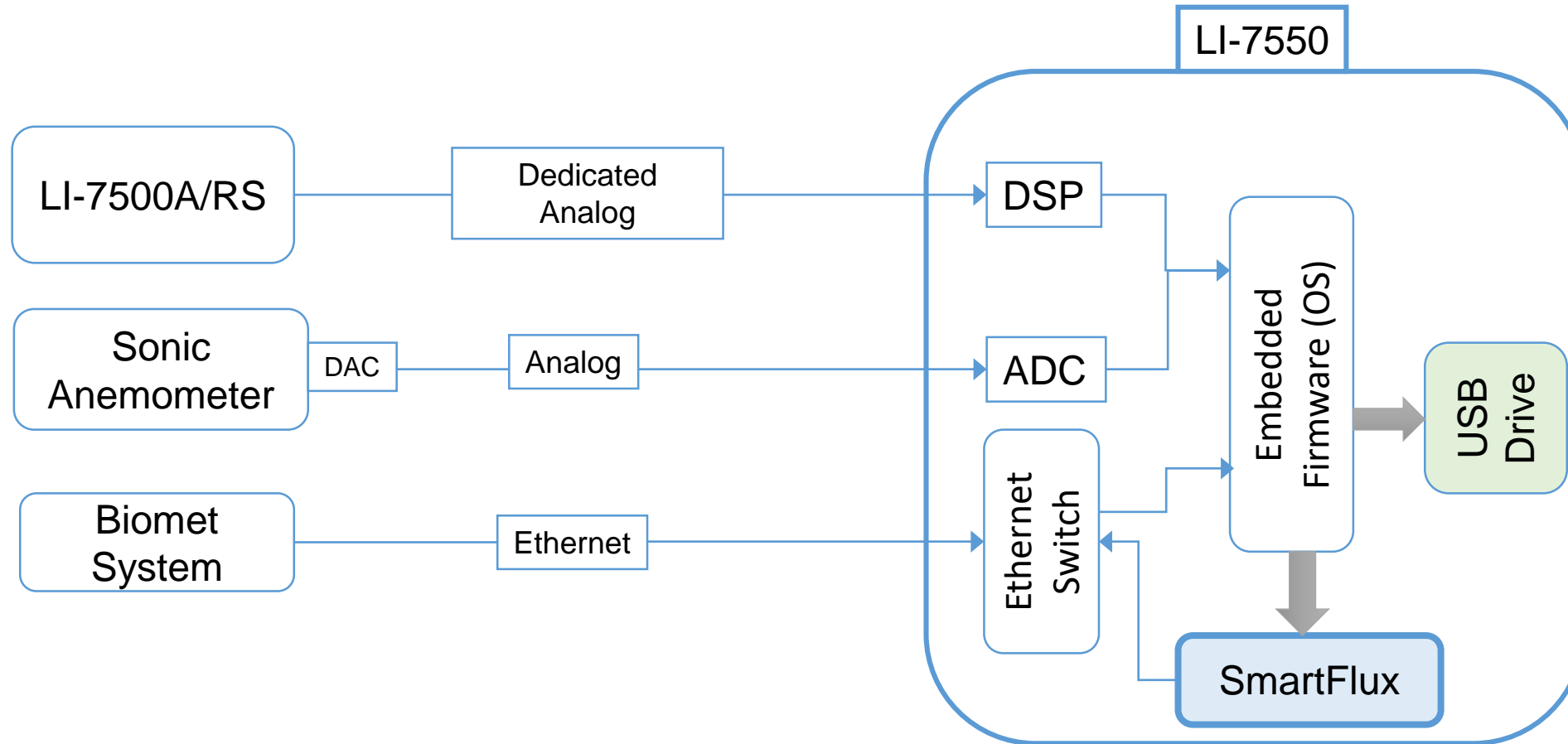
## ... brings EddyPro<sup>®</sup> to your site

- SmartFlux uses EddyPro<sup>®</sup> processing engine at the site and in real-time
- Includes **ALL** the corrections and processing options listed
- SmartFlux 2 and 3 - Digital Sonic Data Acquisition



EddyPro<sup>®</sup> in the Field

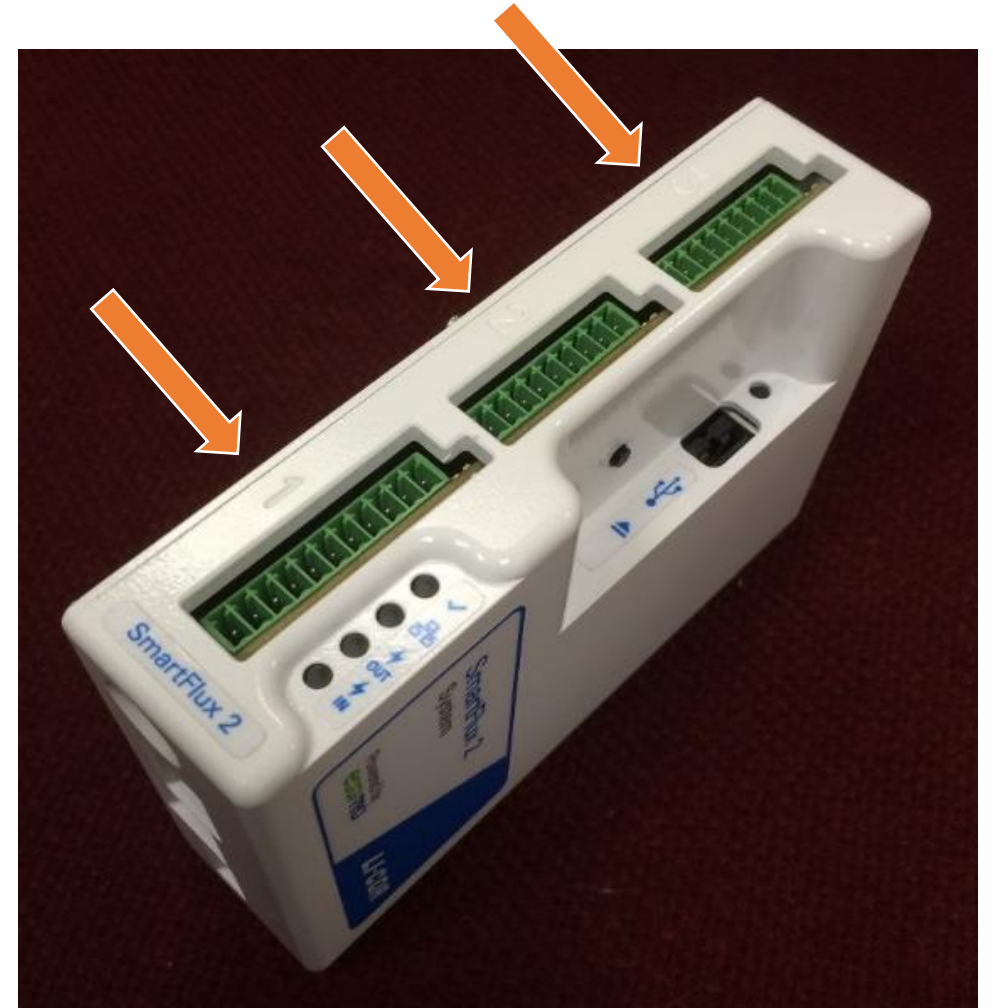
# How does it all come together?





# SmartFlux 2: Specifications

- Serial Ports for digital connection of Sonic Anemometer





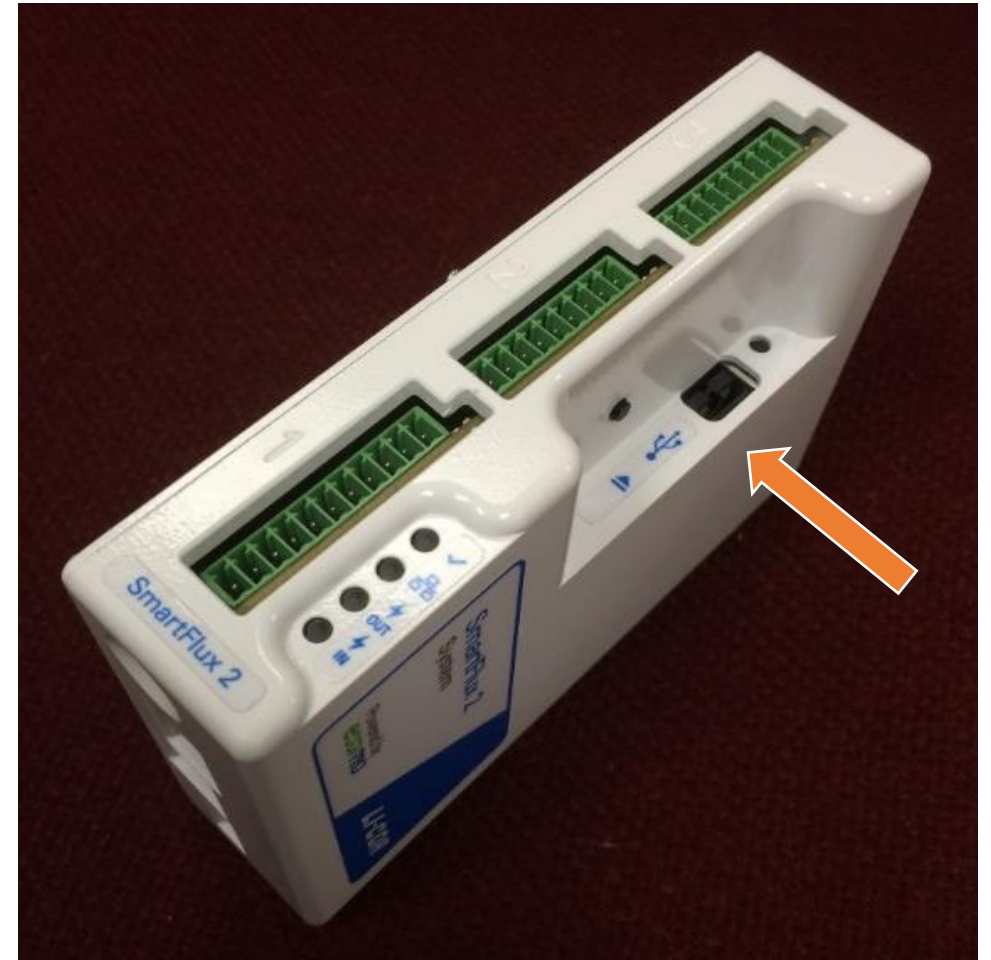
# SmartFlux 2: Specifications

- Serial Ports for digital connection of Sonic Anemometer
- GPS used for PTP synchronization
  - Geographical information

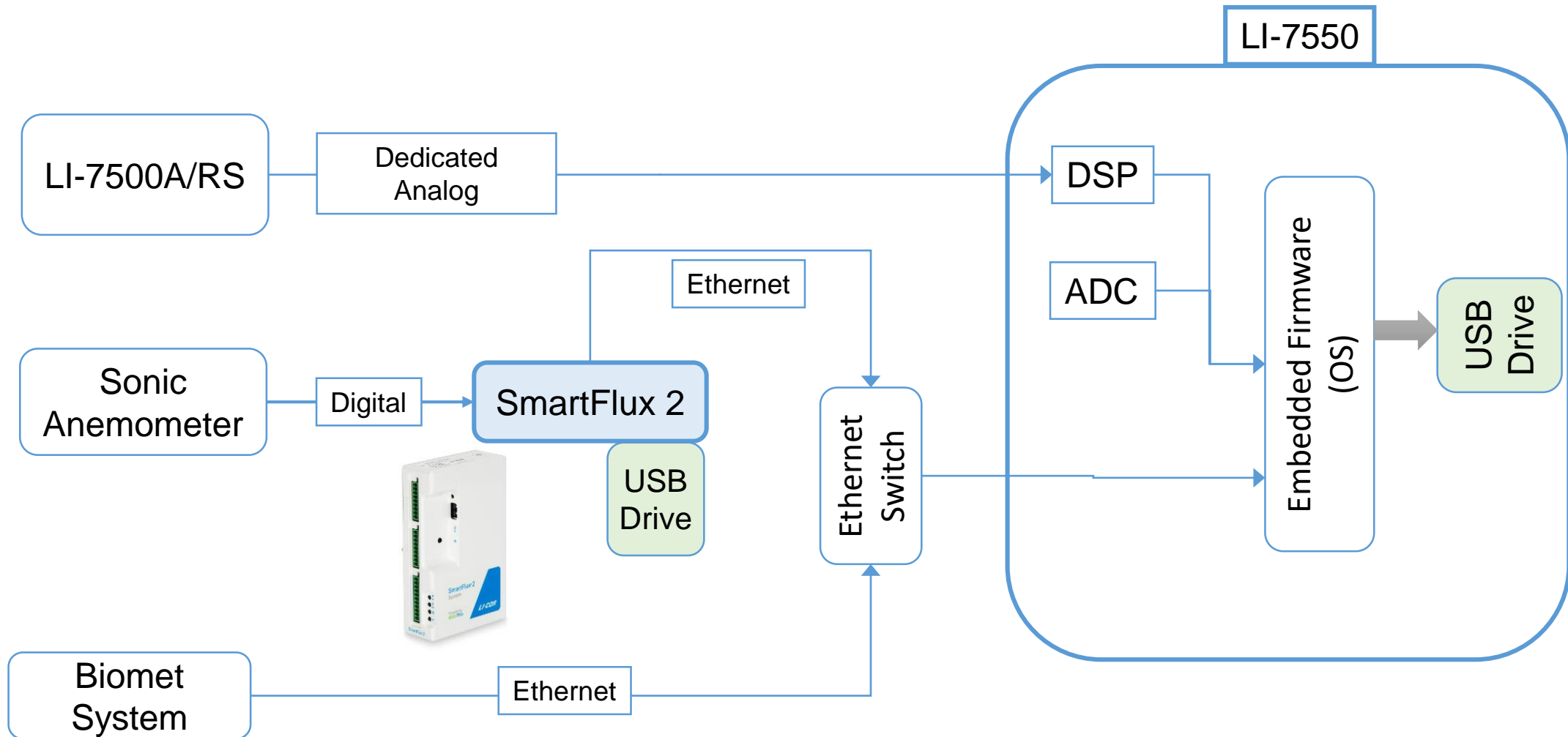


# SmartFlux 2: Specifications

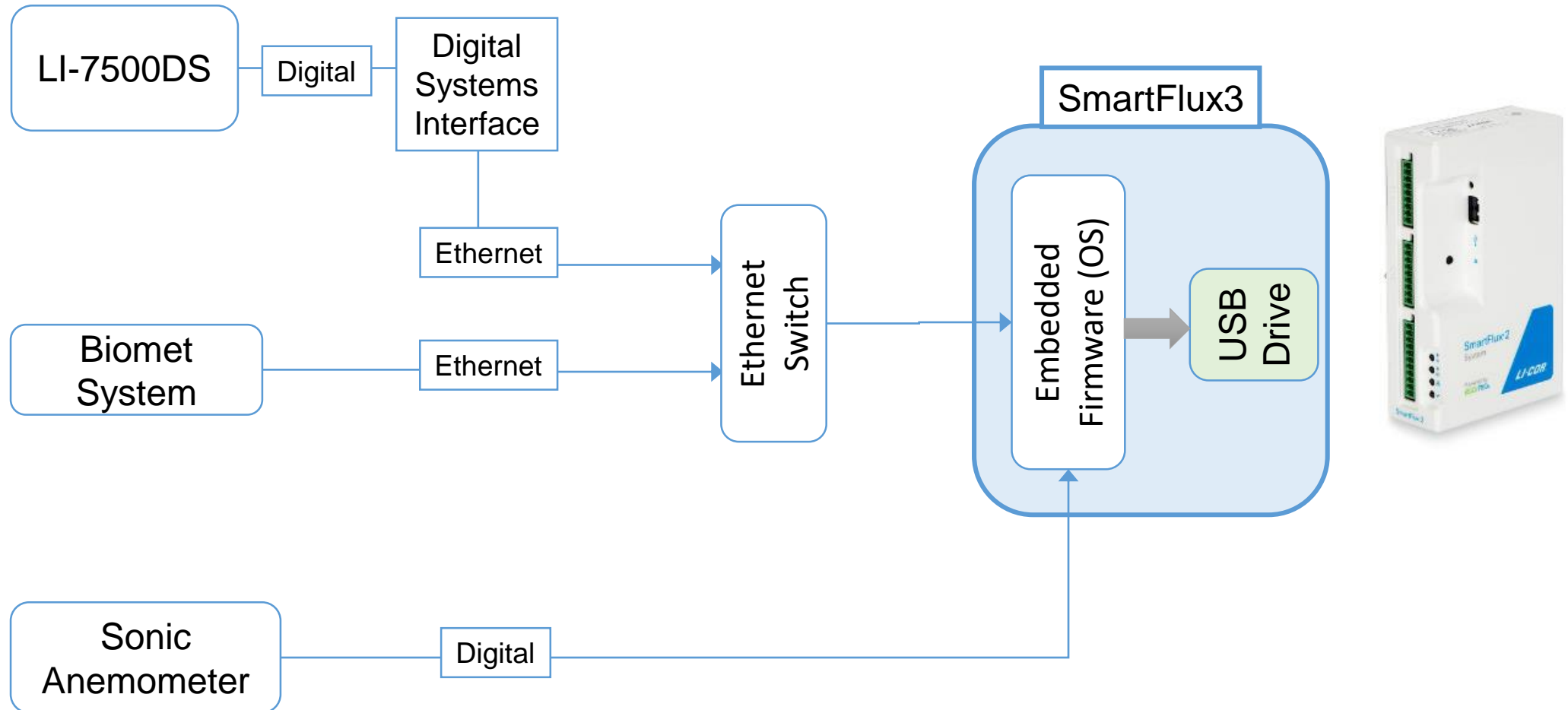
- Serial Ports for digital connection of Sonic Anemometer
- GPS used for PTP synchronization
  - Geographical information
- Another USB drive
  - Secondary back-up
  - Can place at base of tall tower



# How does it all come together with SmartFlux 2?



# How does it all come together with SmartFlux 3?



# Data Flow in the System – LI-7550



## High Speed Data and Metadata

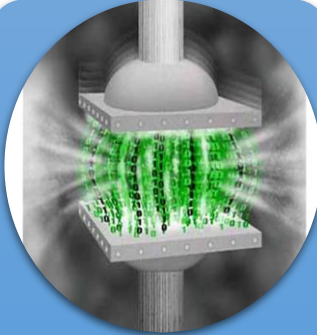
### Logging

LI-7200/RS or  
LI-7500A/RS  
(LI-7700)



## Biomet Data and Metadata Logging

Biomet Data  
Logger Interface  
Net Radiation  
Soil Moisture  
etc.



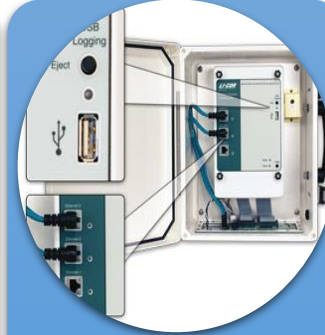
## GHG File Creation

Combine Files  
Compress to  
.GHG format  
Send .GHG files  
to SMARTFlux



## Data Processing

SMARTFlux  
processes data  
Produces fluxes  
and biomet  
averages  
Sends output  
Keeps raw data  
and output



## Data Storage on USB

Raw Data,  
Processed  
Data,  
Summary  
Data

# Raw Data

“. ghg” files  
Raw archives containing four files

EddyPro is optimized  
for LI-COR GHG data

Flux data

Biomet data

**1** High-frequency data  
wind,  
gas concentration, temperatures, etc

**2** Flux metadata  
Measurement height,  
canopy height ,sensor separation, etc

**3** Low-frequency data  
Radiation,  
soil heat flux, air temperature, etc

**4** Biomet metadata  
Variable names,  
units, sampling rates, etc

# Optional Solutions

- SmartFlux 2 and 3 now allow you to expand your research even more...



# Integrating Soil Flux (or NEE) measurements with Eddy Covariance Measurement



# LI-8100/8150 Soil Flux System



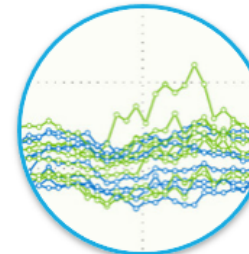
## LI-8100A Automated Soil Gas Flux System

Results So Powerful You Will Never Look Back



### Advanced Chambers

Soil chambers that minimize effects on your measurements – to capture the true flux



### Reliable Measurements

Robust datasets with multiple chambers



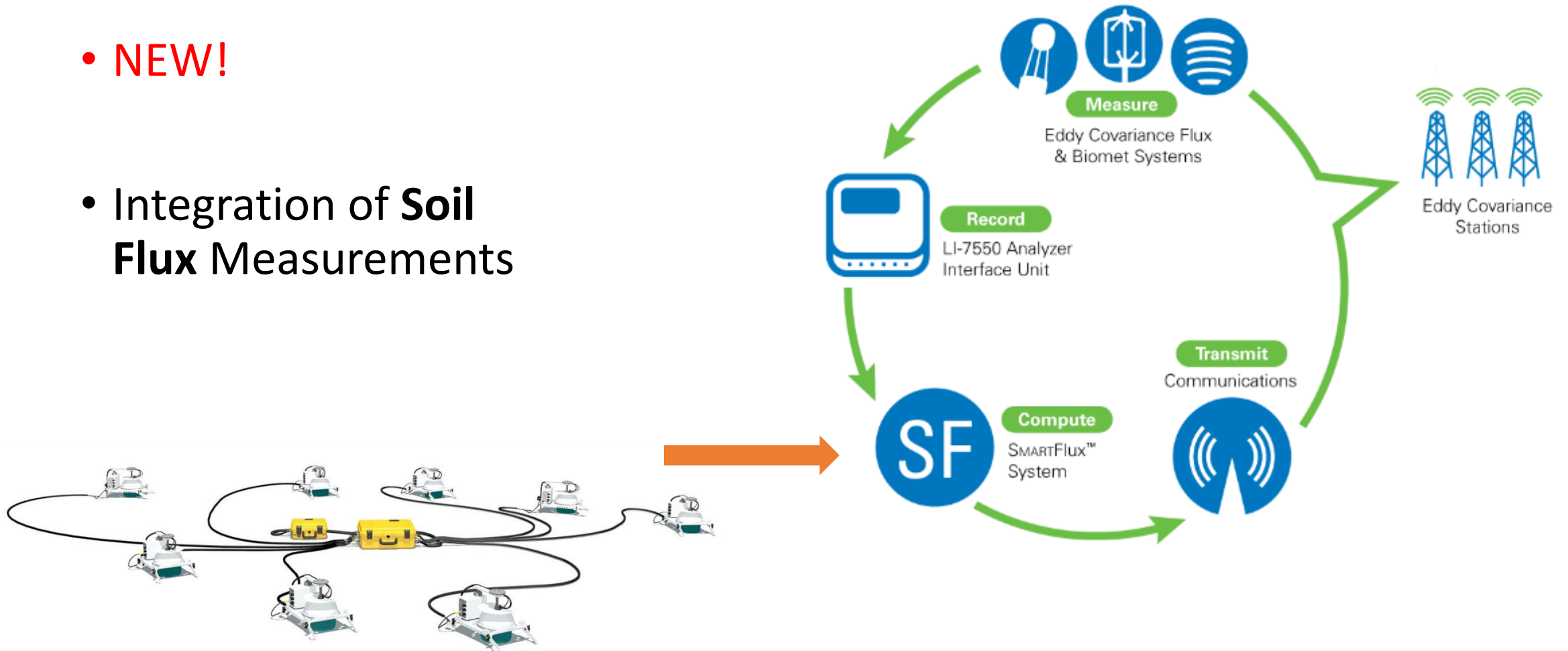
### Continuous Datasets

Long-term measurements of unbroken datasets



# Measurements and Computations

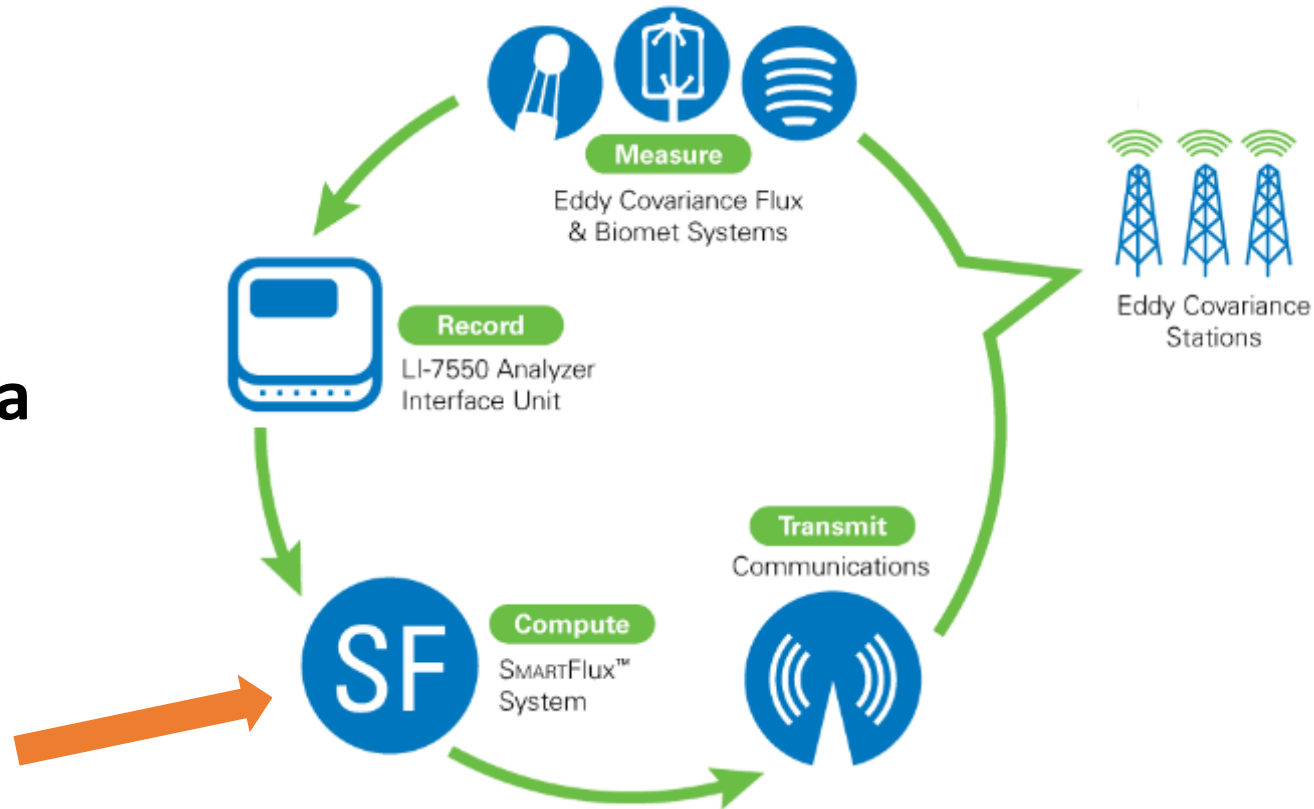
- **NEW!**
- Integration of **Soil Flux Measurements**



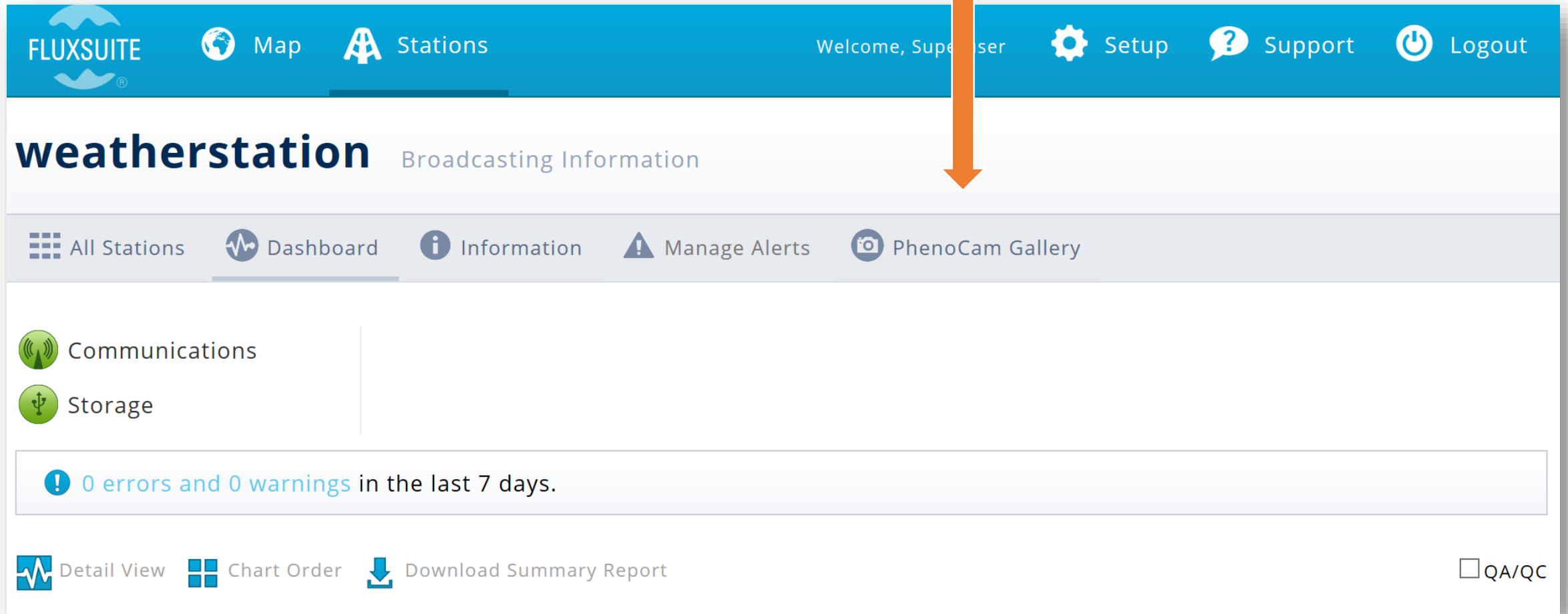
# Measurements and Computations

- **NEW!**

- Integration of **Digital Camera (PhenoCam)** Images



# PhenoCam integration



The screenshot displays the FLUXSUITE web interface. The top navigation bar is blue and contains the FLUXSUITE logo, a 'Map' button with a globe icon, a 'Stations' button with a tower icon, a user greeting 'Welcome, Super user', a 'Setup' button with a gear icon, a 'Support' button with a question mark icon, and a 'Logout' button with a power icon. Below the navigation bar, the main content area has a header 'weatherstation' with the subtitle 'Broadcasting Information'. A secondary navigation bar contains five tabs: 'All Stations' (grid icon), 'Dashboard' (line graph icon), 'Information' (info icon), 'Manage Alerts' (warning triangle icon), and 'PhenoCam Gallery' (camera icon). The 'PhenoCam Gallery' tab is highlighted. On the left side of the main content area, there are two green circular icons: one for 'Communications' (signal waves) and one for 'Storage' (USB drive). Below these is a light blue box with a warning icon and the text '0 errors and 0 warnings in the last 7 days.' At the bottom of the interface, there are three buttons: 'Detail View' (line graph icon), 'Chart Order' (grid icon), and 'Download Summary Report' (download icon). In the bottom right corner, there is a checkbox labeled 'QA/QC'.

FLUXSUITE Map Stations Welcome, Super user Setup Support Logout

## weatherstation

Broadcasting Information

All Stations Dashboard Information Manage Alerts PhenoCam Gallery

Communications

Storage

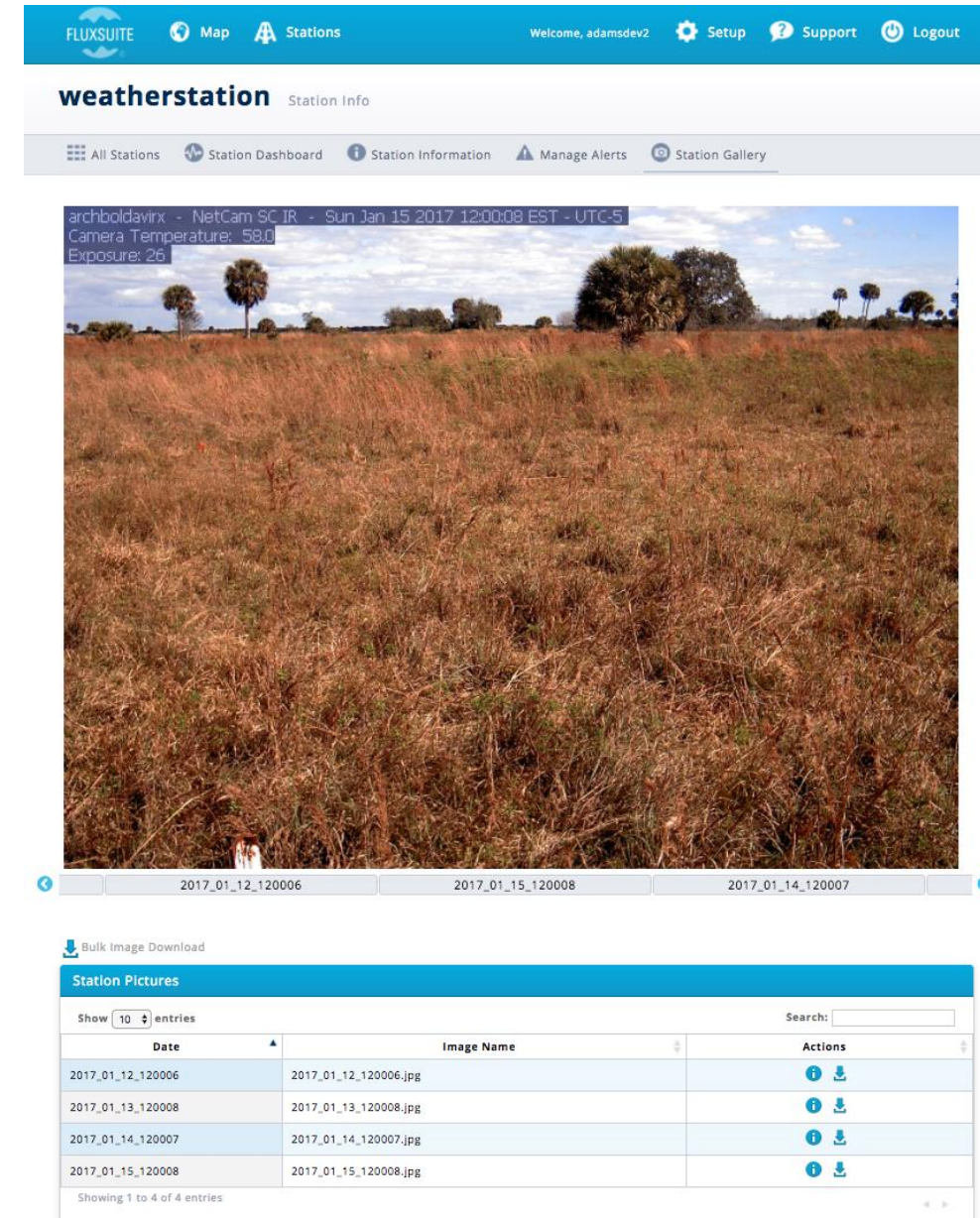
! 0 errors and 0 warnings in the last 7 days.

Detail View Chart Order Download Summary Report

☐ QA/QC

# New! Digital Camera (PhenoCam) Image Gallery

Mid-day image uploaded  
every day at 12 pm.  
Past day's images also  
stored.



FLUXSUITE Map Stations Welcome, adamsdev2 Setup Support Logout

**weatherstation** Station Info

All Stations Station Dashboard Station Information Manage Alerts Station Gallery

archboldavirx - NetCam SC IR - Sun Jan 15 2017 12:00:08 EST - UTC-5  
Camera Temperature: 58.0  
Exposure: 26

2017\_01\_12\_120006 2017\_01\_15\_120008 2017\_01\_14\_120007

Bulk Image Download

**Station Pictures**

Show 10 entries Search:

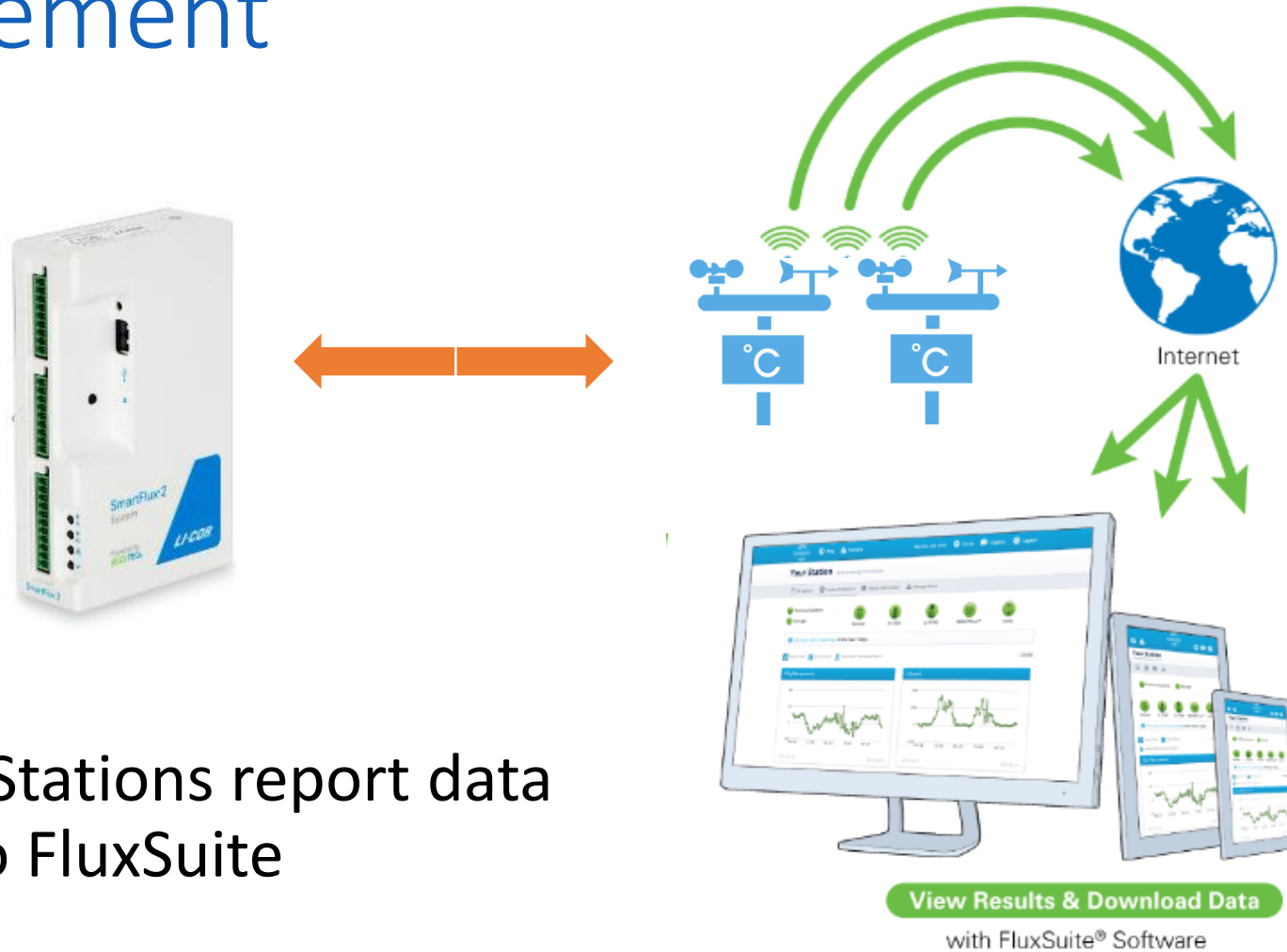
Date	Image Name	Actions
2017_01_12_120006	2017_01_12_120006.jpg	<a href="#">i</a> <a href="#">d</a>
2017_01_13_120008	2017_01_13_120008.jpg	<a href="#">i</a> <a href="#">d</a>
2017_01_14_120007	2017_01_14_120007.jpg	<a href="#">i</a> <a href="#">d</a>
2017_01_15_120008	2017_01_15_120008.jpg	<a href="#">i</a> <a href="#">d</a>

Showing 1 to 4 of 4 entries

# Weather Station Monitoring and Data Management




- **NEW!**




- Weather Stations report data directly to FluxSuite





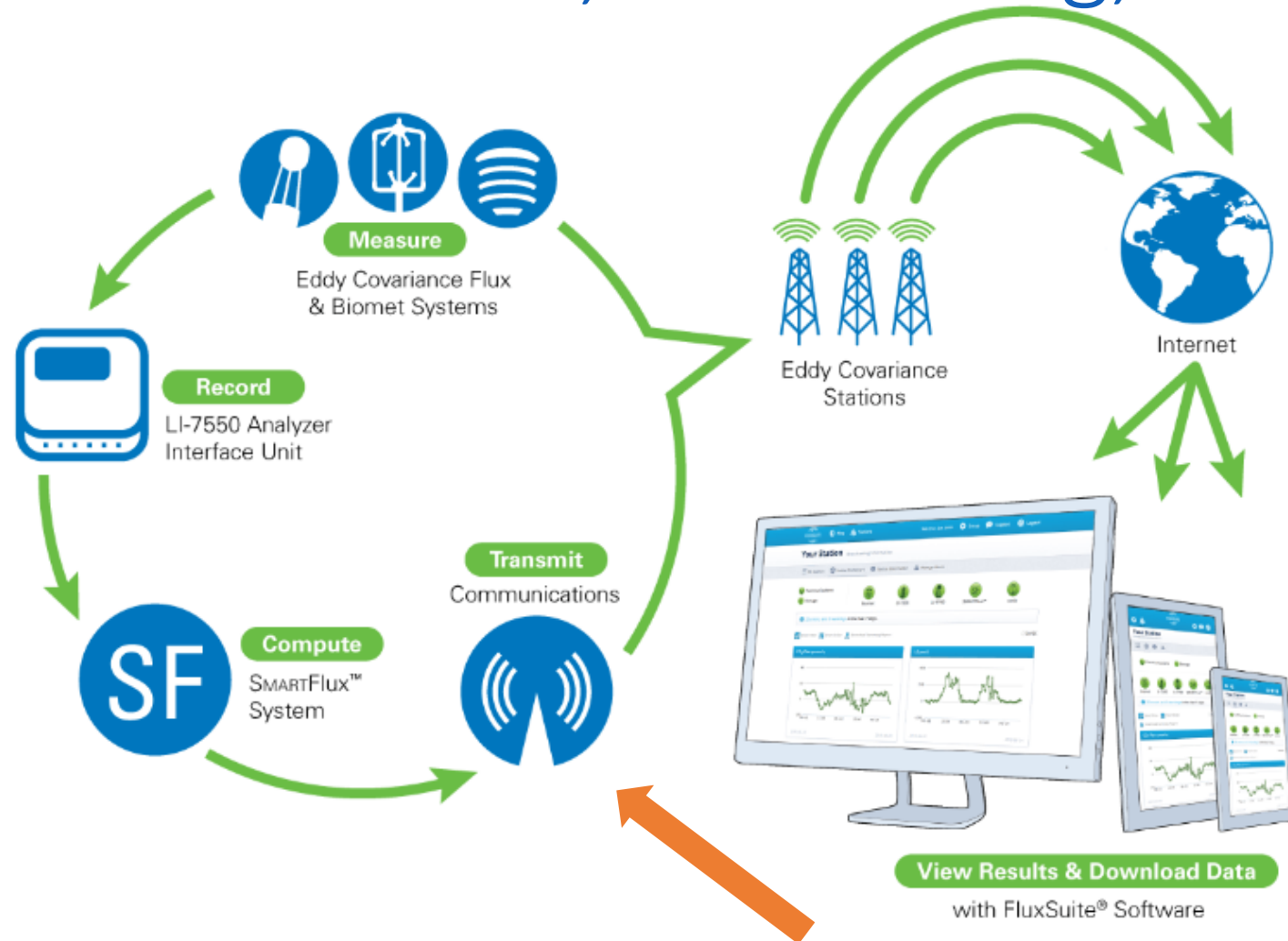
# Weather Station integration

  Map  Stations

Welcome, Superuser  Setup  Support  Logout

Show  entries  add entry Search: © 2015 LI-COR, Inc. License #FS-00001 [Terms & Conditions](#) | [Copyrights & Trademarks](#)

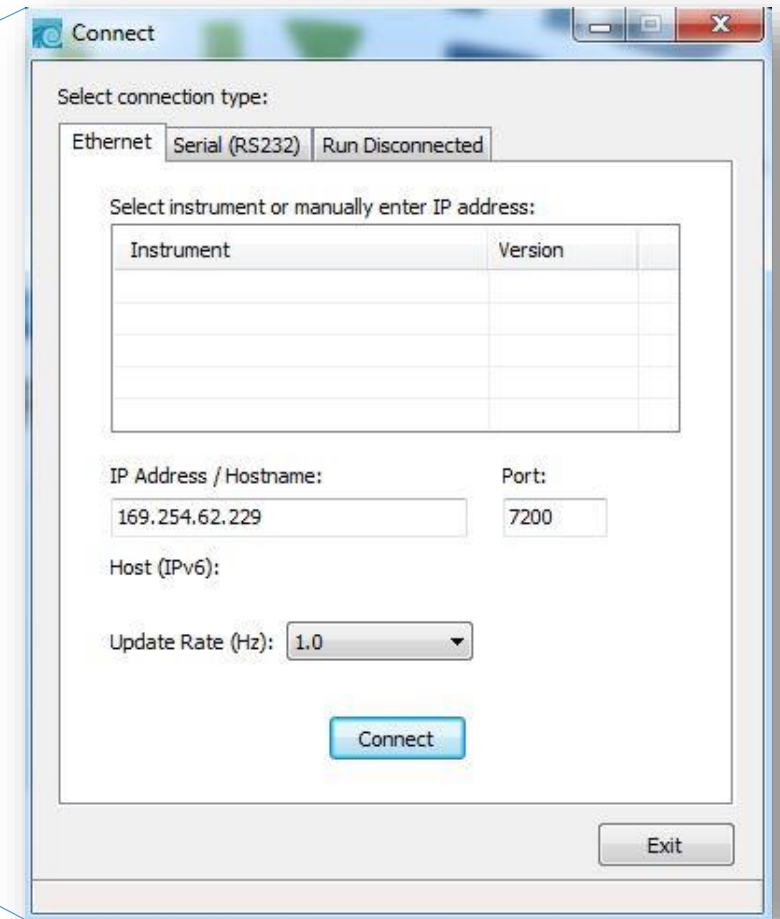
# Data Transfer, Monitoring, and Management



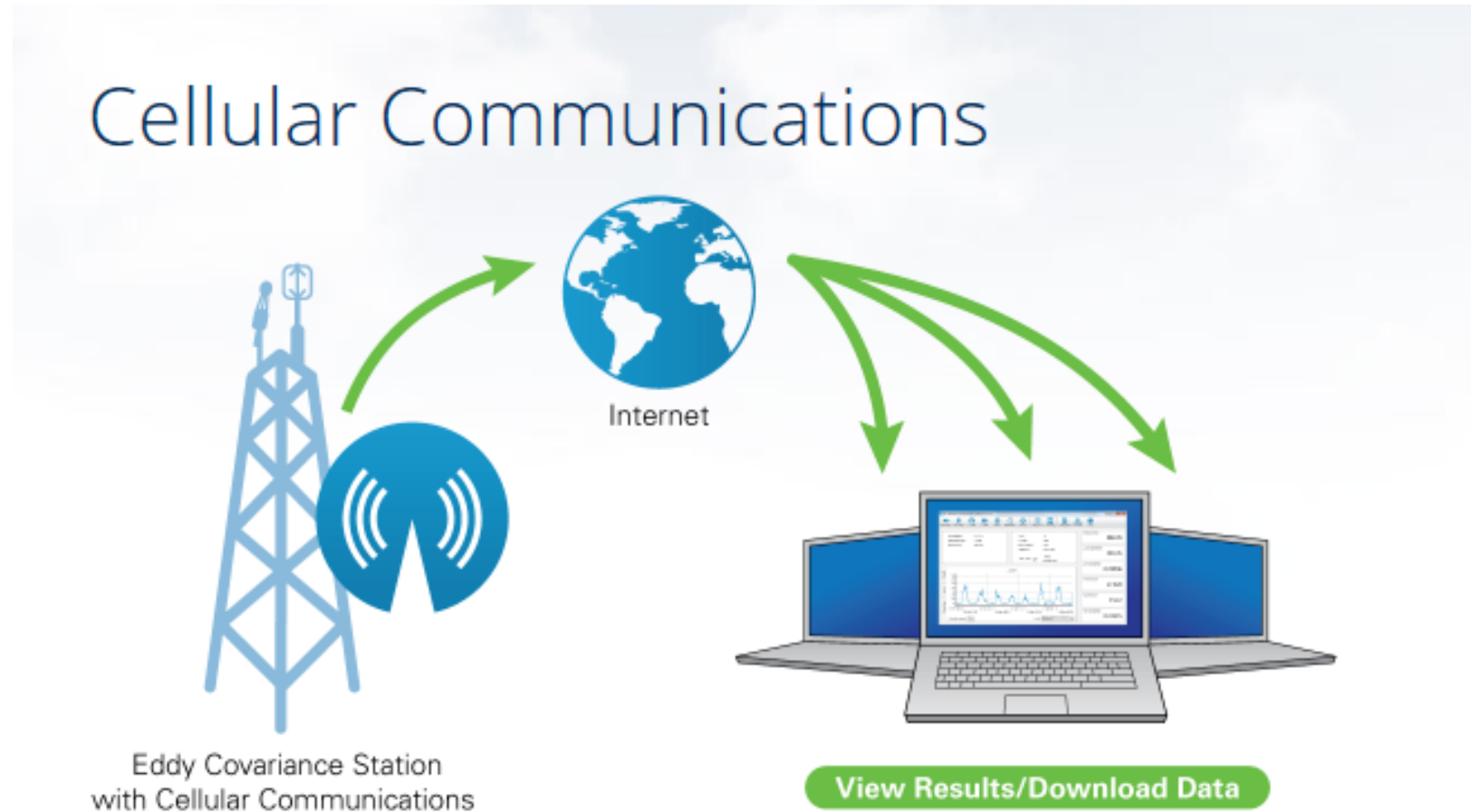
- System Monitoring
- Remote Connection and Data Transfer

# System Monitoring – Direct Connection at the Site

- LI-7550 + Computer
- Windows® Interface

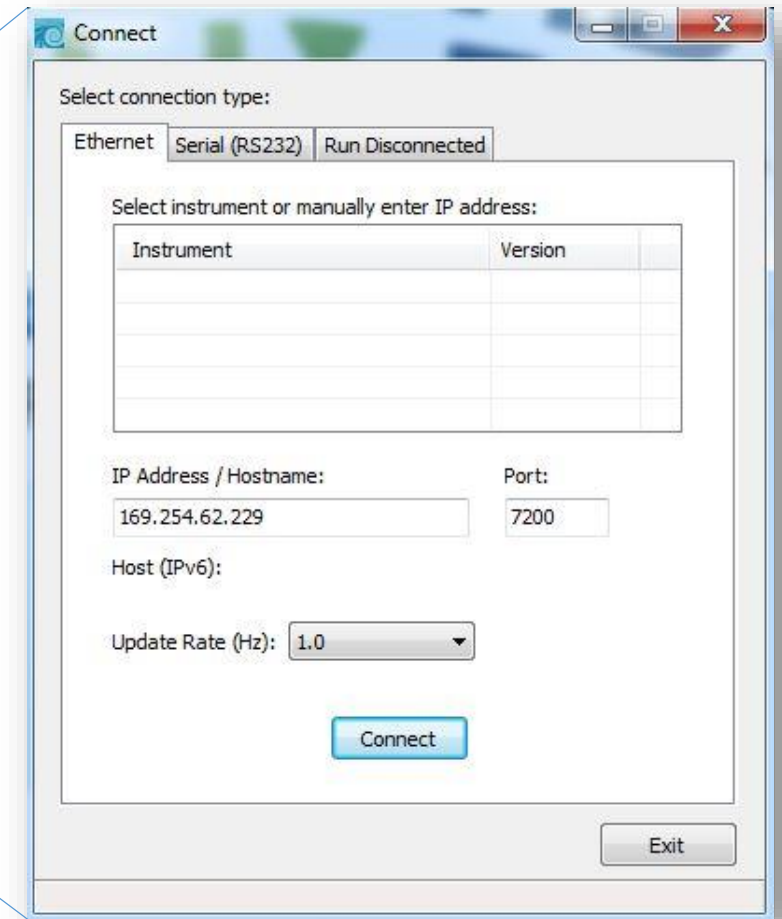


# Remote access and communications



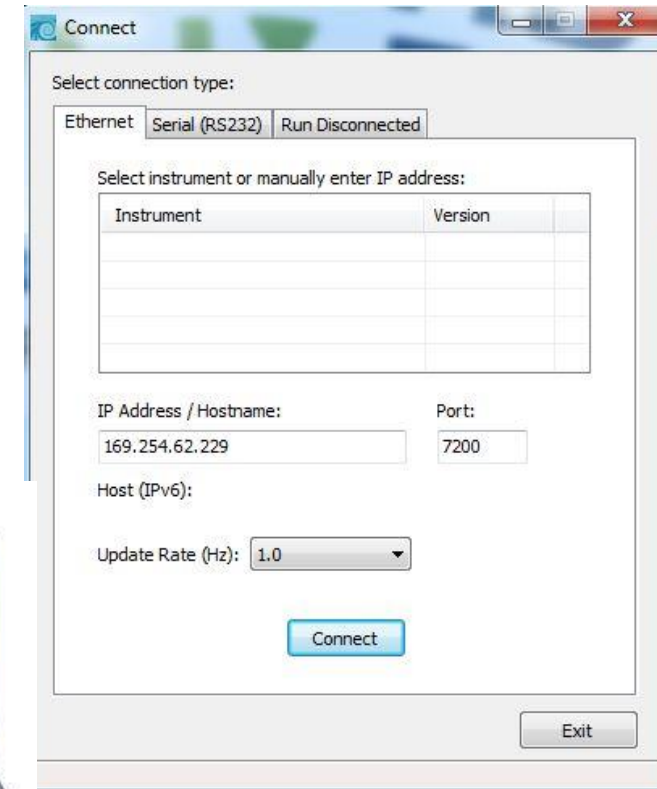
# System Monitoring – Remote Connection from office, lab, conference ...

- LI-7550 + Computer
- Windows® Interface



## System Monitoring – Remote Connection from office, lab, conference ...

- LI-7550 + Cell Mod
- Windows<sup>®</sup> Interface

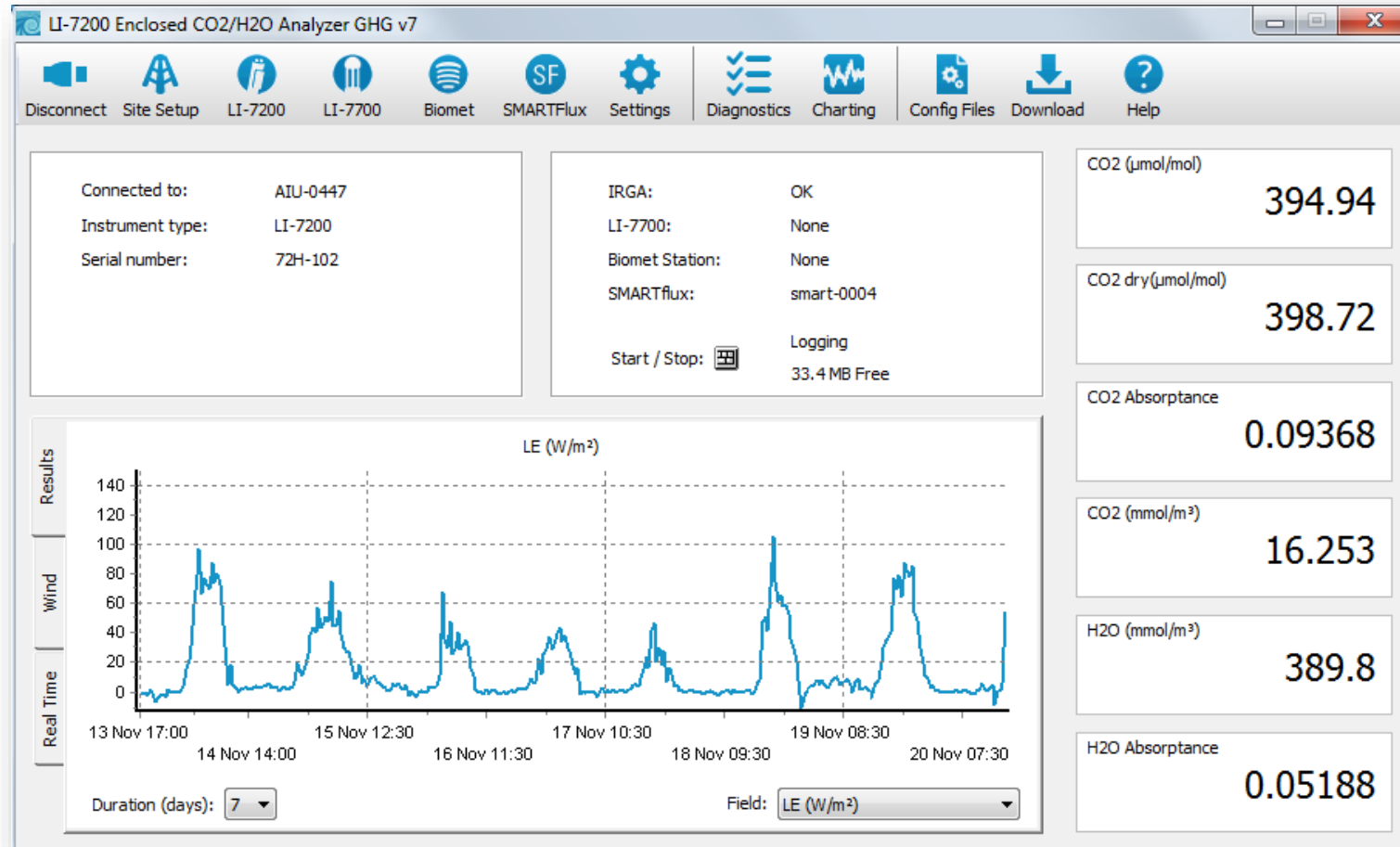




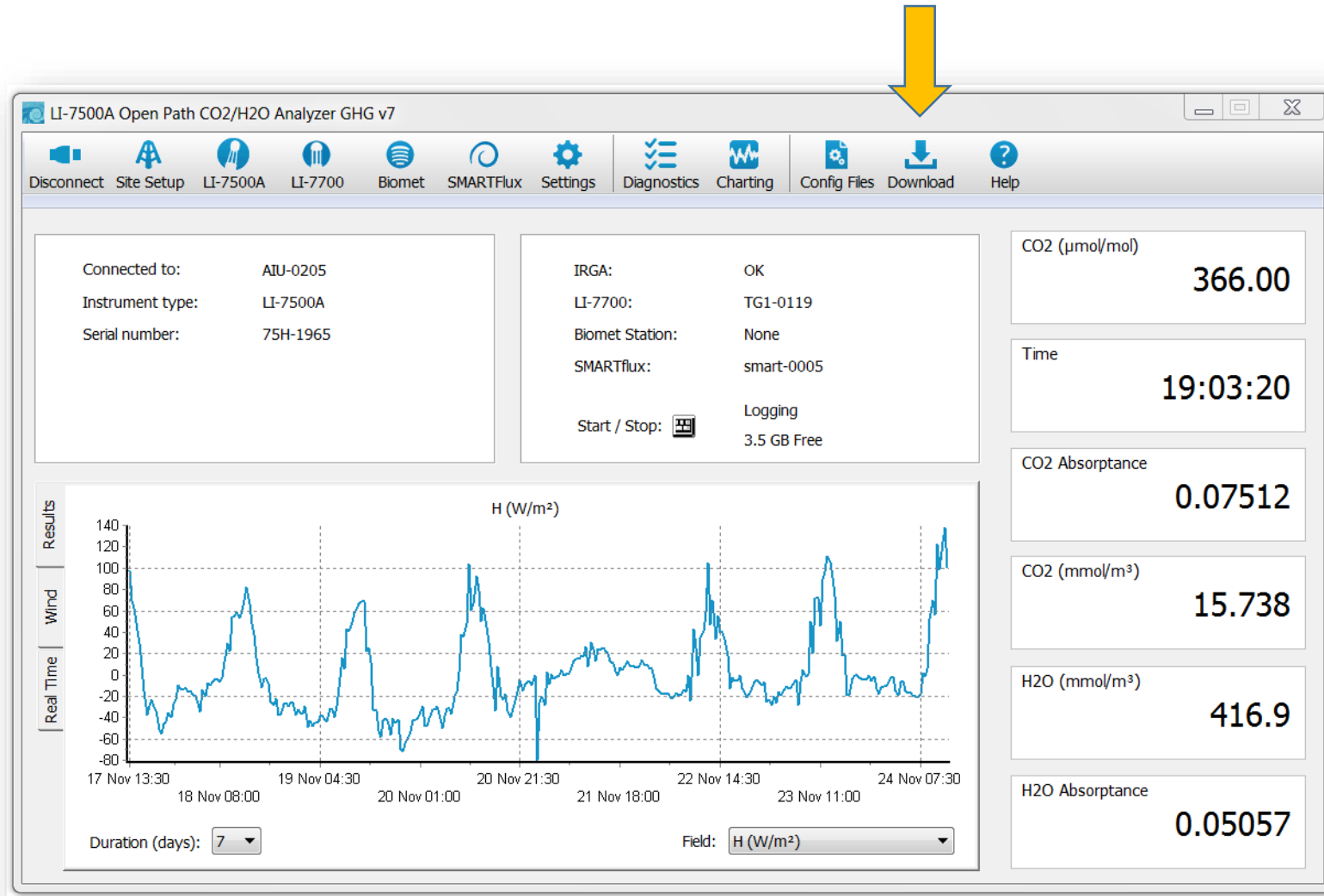
Satellite can be an option, when no Cell Service, or no easy access to IP addresses



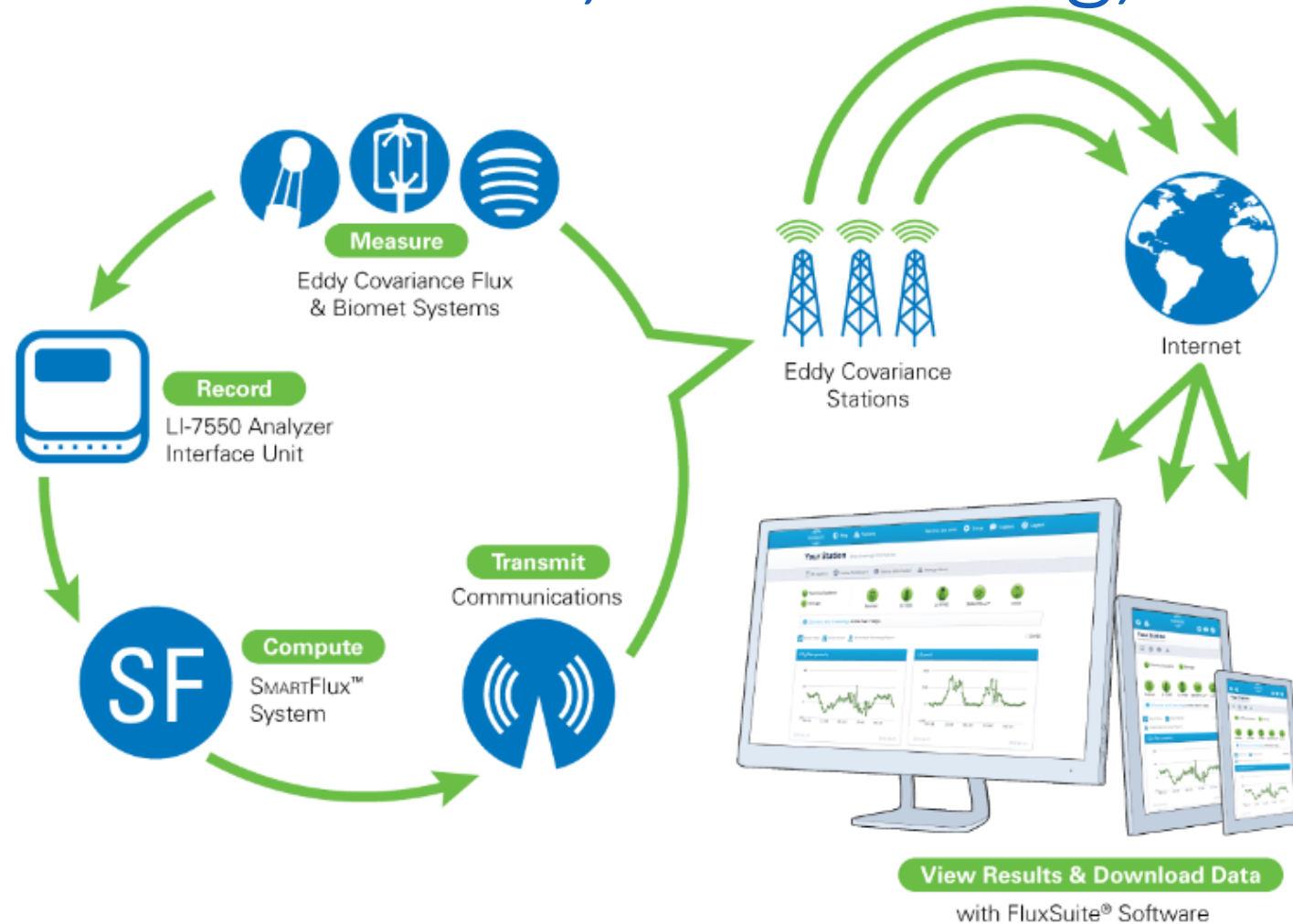
# System Monitoring



# Automatic file transfer




# Data Transfer, Monitoring, and Management



- FluxSuite
- **NEW** improvements and functionality for this Network

# FluxSuite Software: Login Screen

Login



FLUXSUITE

Email Address

Password

Login

Remember Me ☐

[Forgot your password?](#)

# Station Monitoring

FLUXSUITE

Map

Stations

Welcome, Superuser

Setup

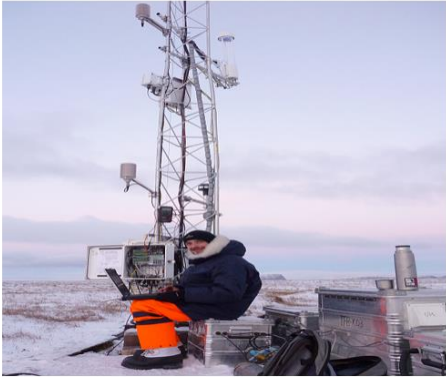
Support

Logout

weatherstation

Station Info

All StationsDashboardInformationManage AlertsPhenoCam Gallery



Name: weatherstation

Abbreviation:

Institute:

Location:

Latitude/Longitude:

Ecosystem:

Elevation:

Generate Station KeyDeactivate Station

FLUXSUITE

Map

Stations

Welcome, Superuser

Setup


Support

Logout

desiel12

Station Info

All StationsDashboardInformationManage Alerts



Name: desiel12

Abbreviation:

Institute:

Location:

Latitude/Longitude: 40.856°, -96.655°

Ecosystem:

Elevation: 358.3 m

Generate Station KeyDeactivate Station

Station Notebook

Show 10 entries

add entry

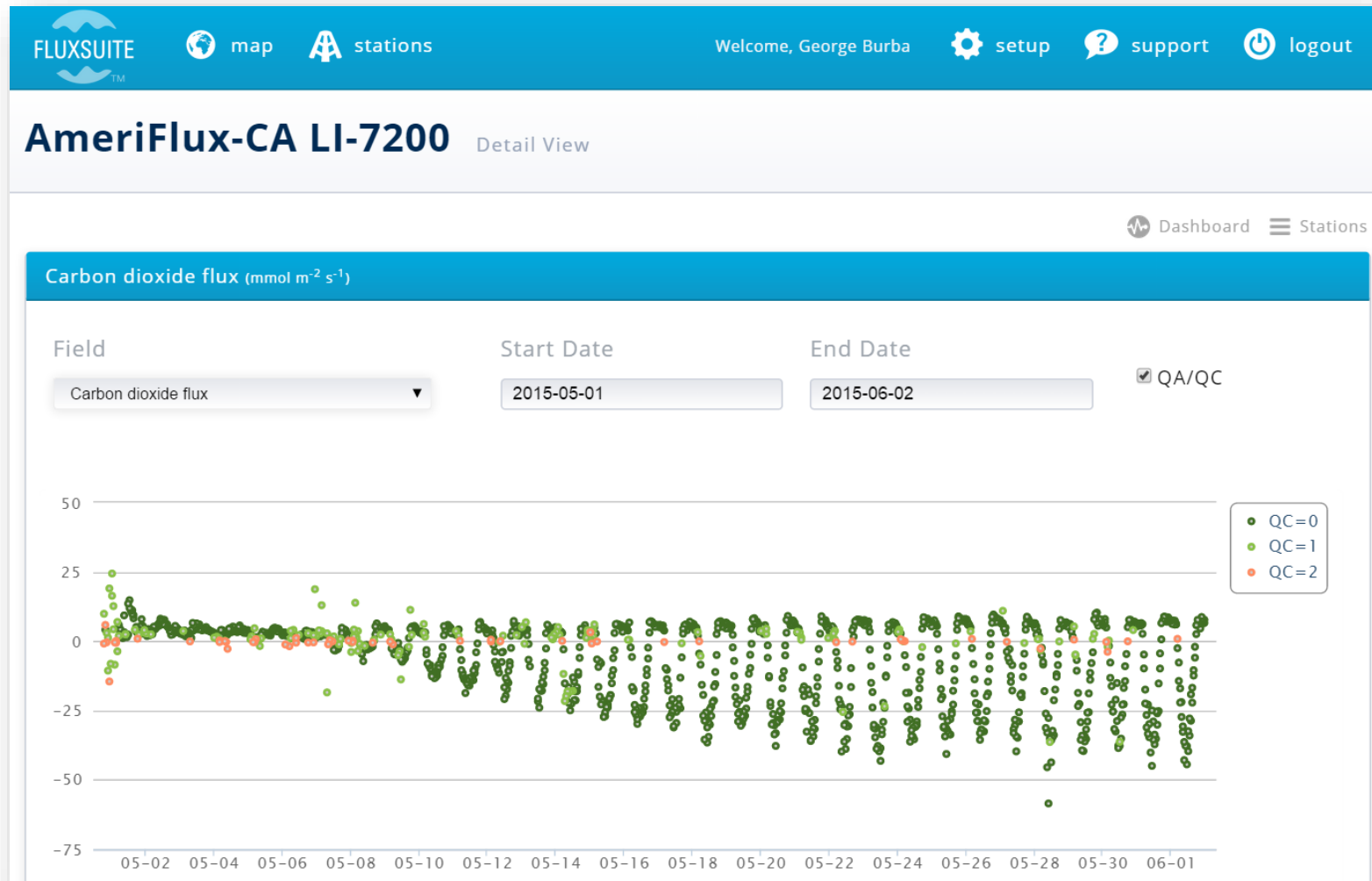
Search:

Note	Author	Timestamp
No data available in table		

Showing 0 to 0 of 0 entries



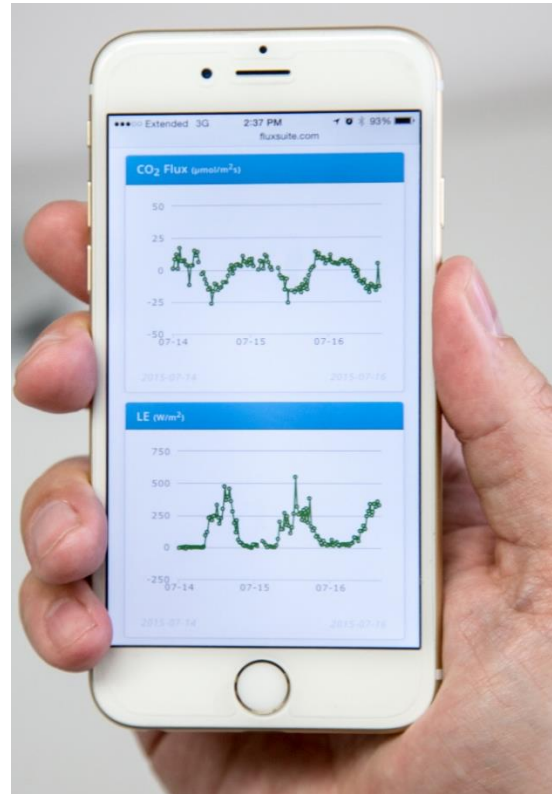
# Detailed View



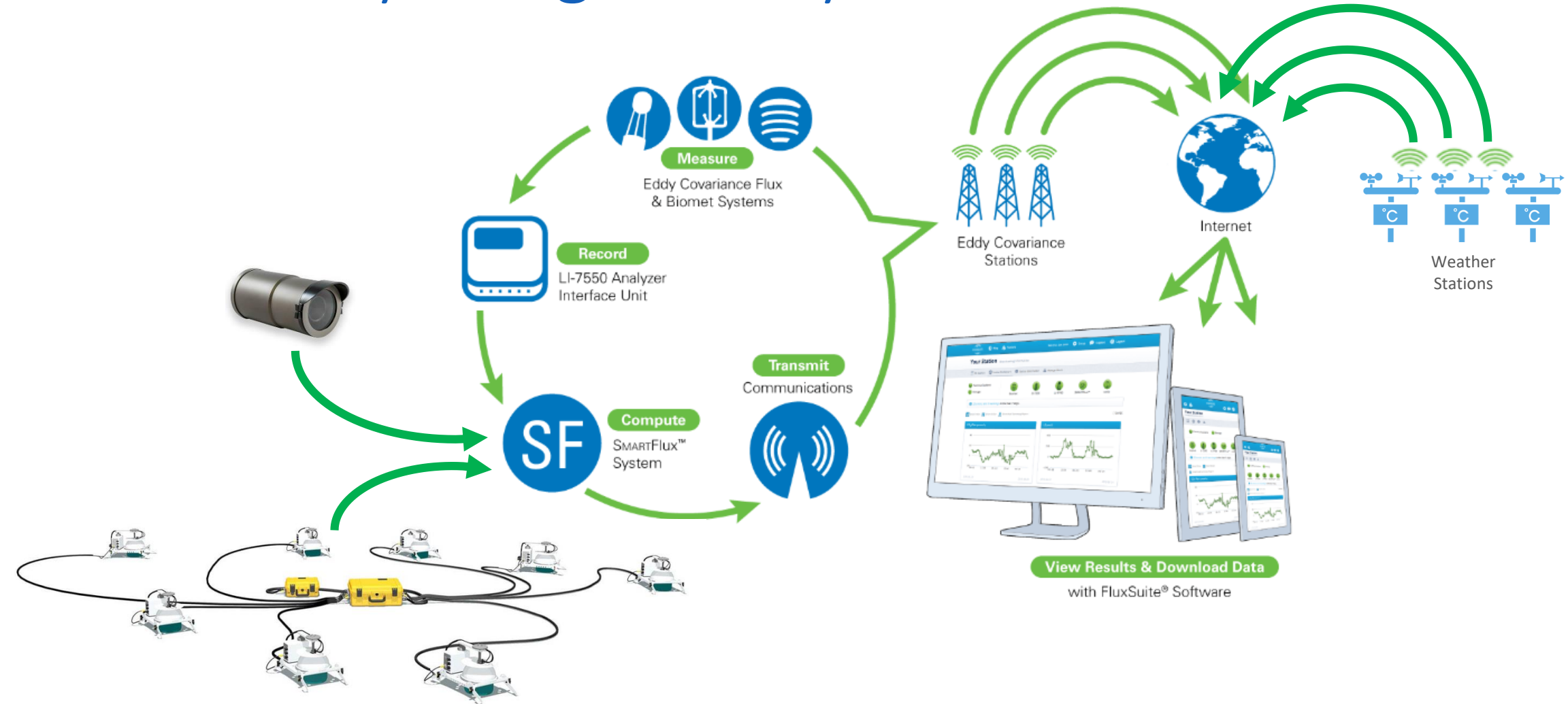
# FluxSuite™ Software



- Monitor – Anywhere. Any time. Any device.



# The fully-integrated System

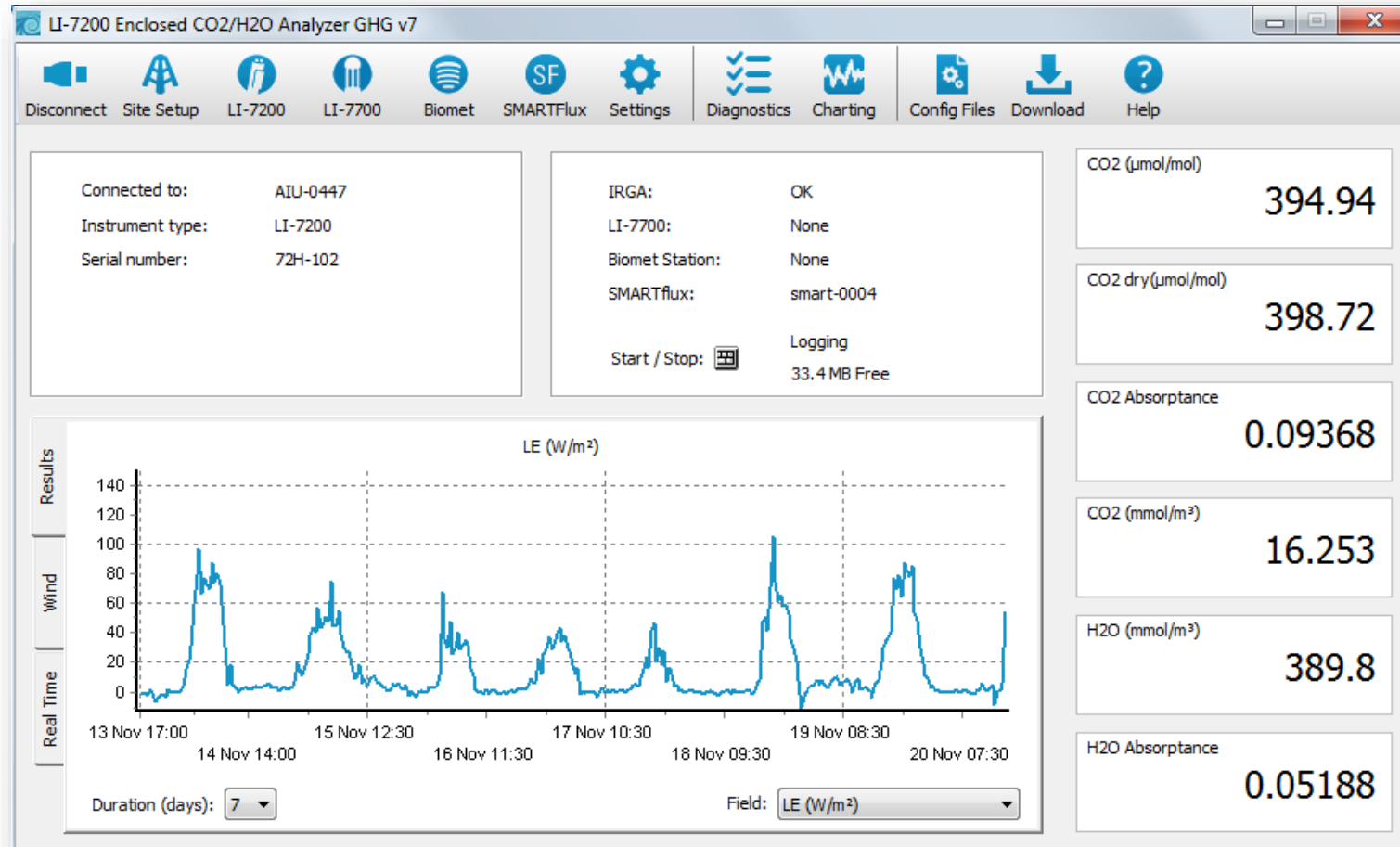


# System Configuration

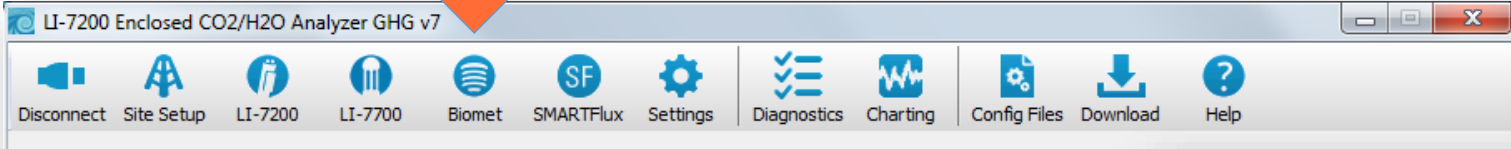
## LI-7500RS Interface Software (GHG)

- Configure LI-7550
- Configure Analyzer and Accessories
- Configure Site Setup and Metadata
- Configure data collection
- Connect to other Components
- Calibrate analyzer

# Windows® Interface Software



# Connect Biomet to LI-7550



LI-7200 Enclosed CO<sub>2</sub>/H<sub>2</sub>O Analyzer GHG v7

Disconnect Site Setup LI-7200 LI-7700 **Biomet** SMARTFlux Settings Diagnostics Charting Config Files Download Help

Connected to: AIU-0447  
Instrument type: LI-7200  
Serial number: 72H-102

IRGA: OK  
LI-7700: None  
Biomet Station: None  
SMARTflux: smart-0004  
Start / Stop: Logging  
33.4 MB Free

Results  
Wind  
Real Time

LE (W/m<sup>2</sup>)

13 Nov 17:00 14 Nov 14:00 15 Nov 12:30 16 Nov 11:30 17 Nov 10:30 18 Nov 09:30 19 Nov 08:30 20 Nov 07:30

Duration (days): 7 Field: LE (W/m<sup>2</sup>)

Settings

Time Network Manual Advanced LI-7700 **Biomet** Integration

Connection Status

Sutron 9210: UC4  
Connection: Ready

Connect to a 9210:

9210 Instrument	IP Address	Serial Number	State
None	-	-	-
UC4	172.25.41.210	1203041	1
LER5_BIOMET	172.25.41.229	1111030	1
relay	172.25.41.233	1106494	1

9210 Hostname:

Connect Disconnect

OK Cancel Apply



# Connect SMARTFlux to LI-7550

The screenshot displays the LI-7200 Enclosed CO2/H2O Analyzer GHG v7 software interface. An orange arrow points to the SMARTFlux icon in the top toolbar. A 'Smart Flux' dialog box is open, showing the 'Processing Options' tab. The dialog prompts the user to 'Choose the Smartflux unit that is directly connected to the 7550:'. A table lists available units, with 'smart-0109' selected. Below the table are 'Connect' and 'Disconnect' buttons. The 'Connection Status' section shows 'Connected to: smart-0109'. A callout box with an arrow points to this status, stating 'Indicates the connected SMARTFlux Unit'. The background software window shows connection details (Connected to: AIU-0447, Instrument type: LI-7200, Serial number: 72H-102) and a graph of LE (W/m²) over time.

LI-7200 Enclosed CO2/H2O Analyzer GHG v7

Disconnect Site Setup LI-7200 LI-7700 Biomet SMARTFlux Settings Diagnostics Charting Config Files Download Help

Connected to: AIU-0447  
Instrument type: LI-7200  
Serial number: 72H-102

IRGA: OK  
LI-7700: None  
Biomet Station: None  
SMARTflux: smart-0004  
Start / Stop: [Icon] Logging 33.4 MB Free

Results  
Wind  
Real Time

LE (W/m²)

13 Nov 17:00 14 Nov 14:00 15 Nov 12:30 16 Nov 11:30 17 Nov 10:30 18 Nov 09:30 19 Nov 08:30 20 Nov 07:30

Duration (days): 7 Field: LE (W/m²)

Smart Flux Processing Options

Choose the Smartflux unit that is directly connected to the 7550:

Name	Version	IP Address
None	-	-
smart-0109	0.0.16	172.24.80.27

Connect Disconnect

Connection Status

Connected to: smart-0109

Indicates the connected SMARTFlux Unit

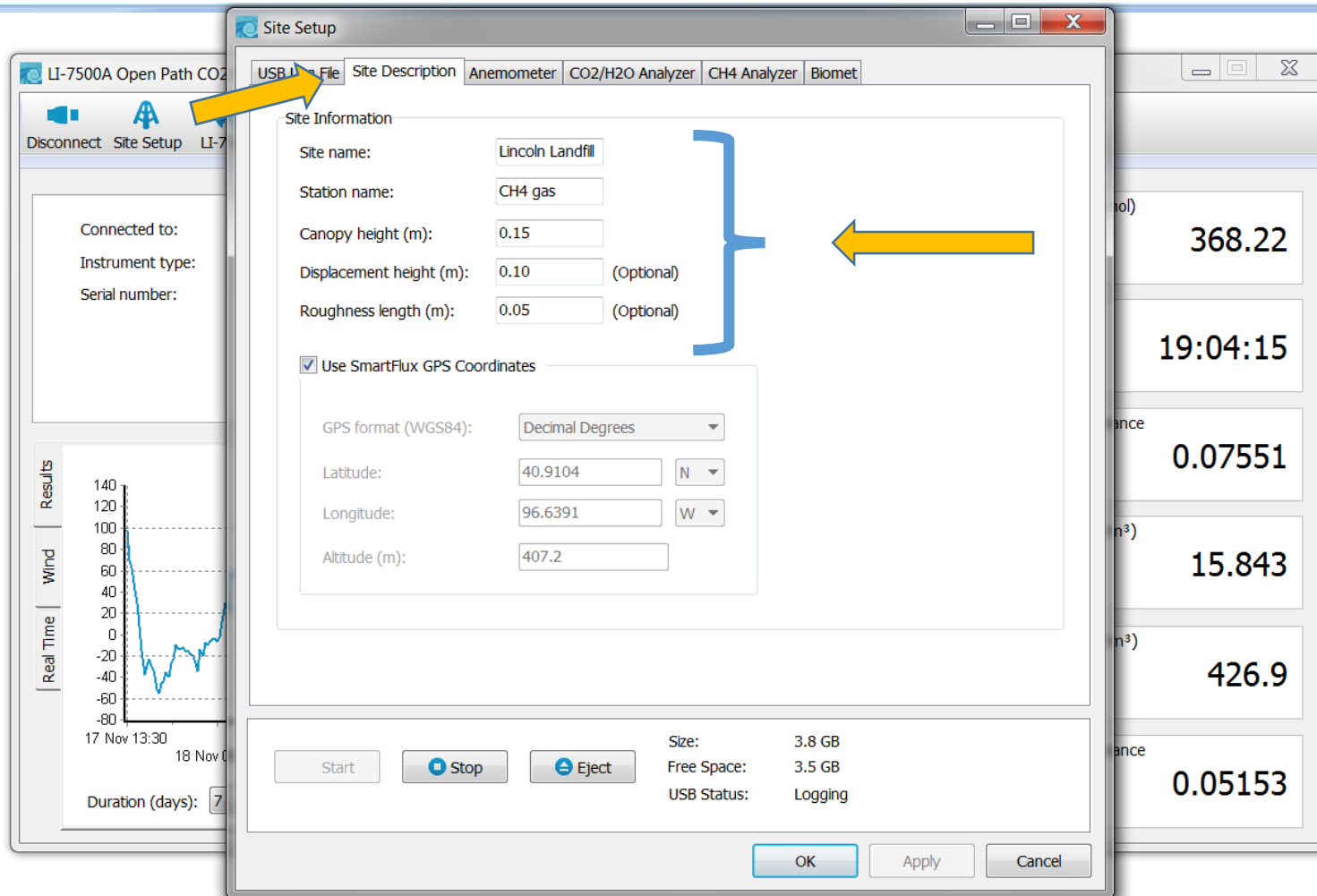
Close

# Collect and record metadata (field-site information)...

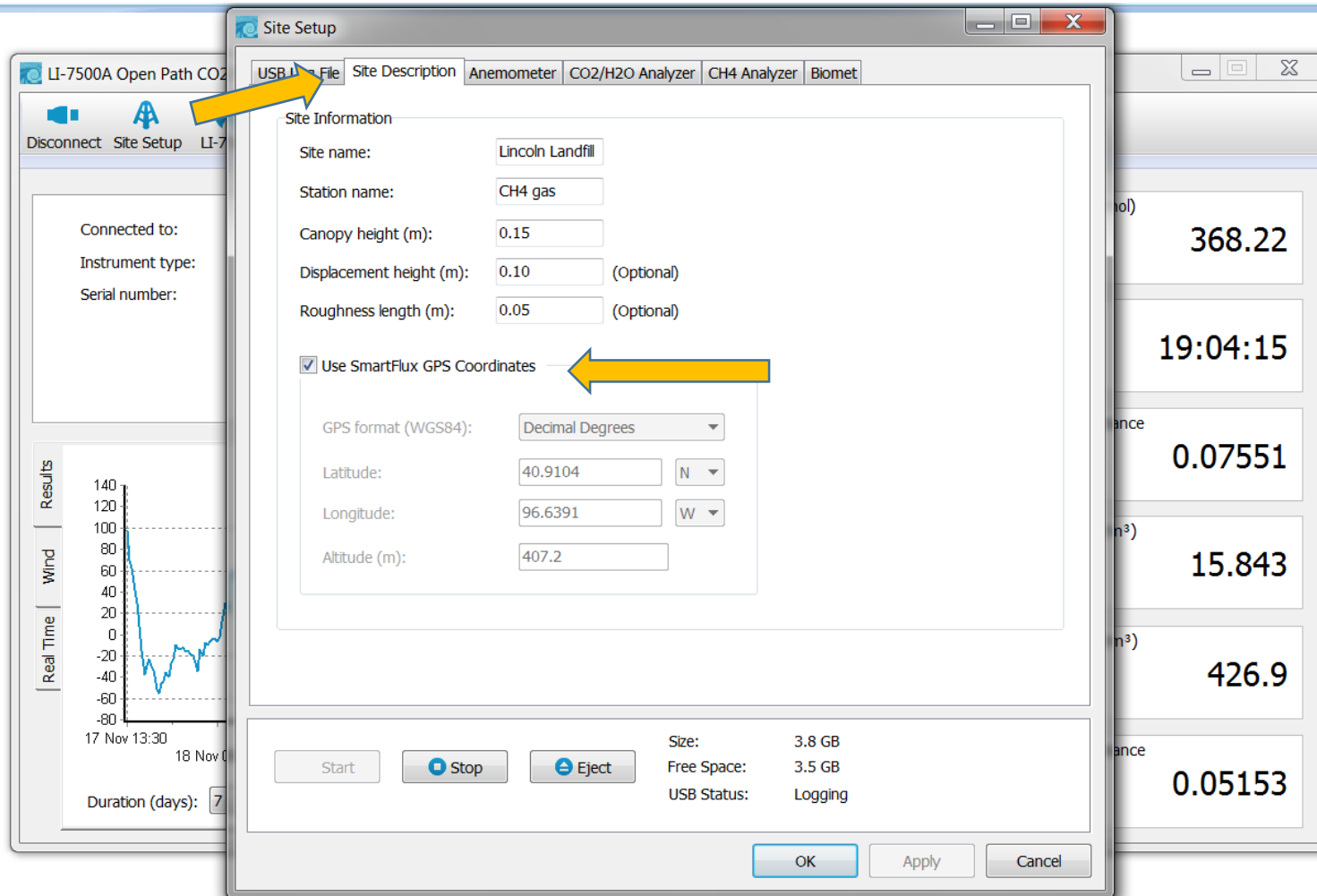
- Needed for processing raw data into accurate, computed flux values.
- Can be done manually and entered during post-processing.
- Better...can be done at start up in Instrument software.
- Can easily be read and used by EddyPro and/or SMARTflux.



# Recording site metadata...



# Recording site metadata...



## Recording metadata...

The image shows a 'Site Setup' dialog box with several tabs: 'USB Log File', 'Site Description', 'Anemometer', 'CO2/H2O Analyzer', 'CH4 Analyzer', and 'Biomet'. The 'Anemometer' tab is selected, displaying the 'Anemometer Settings' section. This section includes dropdown menus for 'Manufacturer' (set to 'Campbell') and 'Model' (set to 'CSAT3'), a checkbox for 'Head correction applied internally' (checked), a dropdown for 'Wind data format' (set to 'U, V, W'), and text input fields for 'North offset (°)' (167) and 'Height (m)' (4.0894). An 'Input Settings...' button is located below these fields. At the bottom of the dialog, there are 'Start', 'Stop', and 'Eject' buttons, followed by a status area showing 'Size: 3.8 GB', 'Free Space: 36.6 MB', and 'USB Status: Logging'. 'OK', 'Apply', and 'Cancel' buttons are at the very bottom.

Site Setup

USB Log File Site Description **Anemometer** CO2/H2O Analyzer CH4 Analyzer Biomet

Anemometer Settings

Manufacturer: Campbell

Model: CSAT3 ☒ Head correction applied internally

Wind data format: U, V, W

North offset (°): 167

Height (m): 4.0894

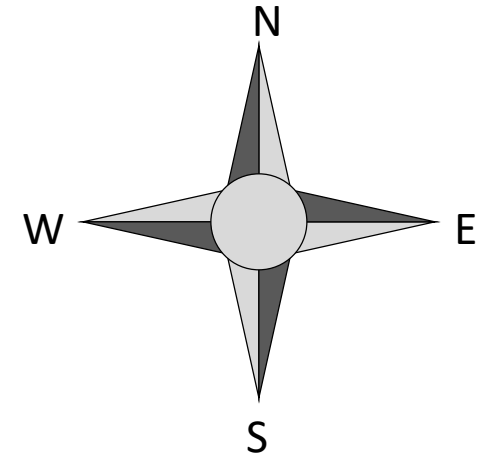
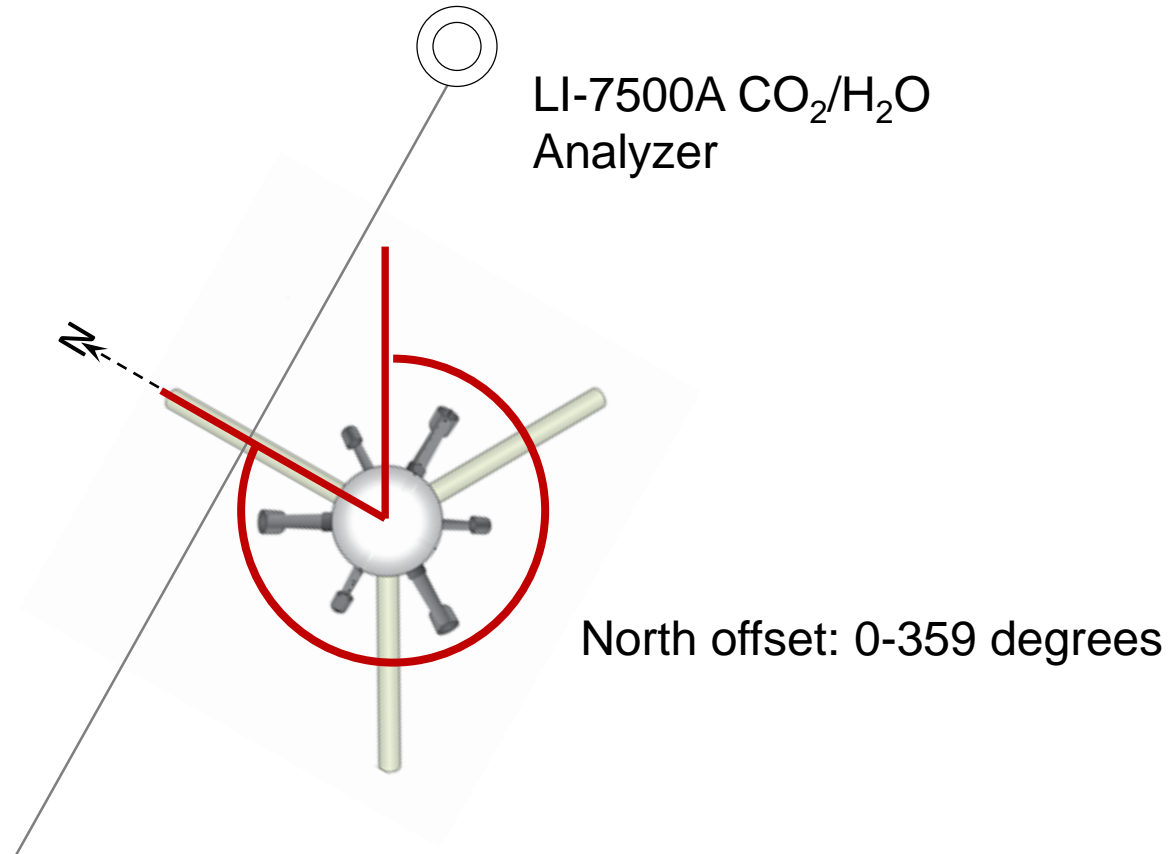
Input Settings...

Start Stop Eject

Size: 3.8 GB  
Free Space: 36.6 MB  
USB Status: Logging

OK Apply Cancel

# Metadata: North Offset





# Recording metadata...

**Site Setup**

USB Log File | Site Description | Anemometer | **CO2/H2O Analyzer** | CH4 Analyzer | Biomet

**CO2/H2O Analyzer**

Analyzer model: LI-7200

Northward separation (cm): 53.34

Eastward separation (cm): 25.4

Vertical separation (cm): 45.72

Tube length (cm): 100.0

Tube diameter (mm): 9.017

... Flow Rate (lpm): 14.2

**CO2/H2O Log Values**

- ☒ Time
- ☒ Date
- ☒ Sequence Number
- ☒ CO2 (mmol/m³)
- ☐ CO2 (mg/m³)
- ☒ CO2 Absorptance
- ☒ CO2 (μmol/mol)
- ☒ CO2 dry(μmol/mol)
- ☒ H2O (mmol/m³)
- ☐ H2O (g/m³)
- ☒ H2O Absorptance
- ☒ H2O (mmol/mol)
- ☒ H2O dry(mmol/mol)
- ☒ Dew Point (°C)
- ☒ Cell Temperature (°C)
- ☒ Temperature In (°C)
- ☒ Temperature Out (°C)
- ☒ Block Temperature (°C)
- ☒ Total Pressure (kPa)
- ☒ Box Pressure (kPa)
- ☒ Head Pressure (kPa)
- ☒ Cooler Voltage (V)
- ☒ Diagnostic Value
- ☒ Diagnostic Value 2
- ☒ CO2 Signal Strength

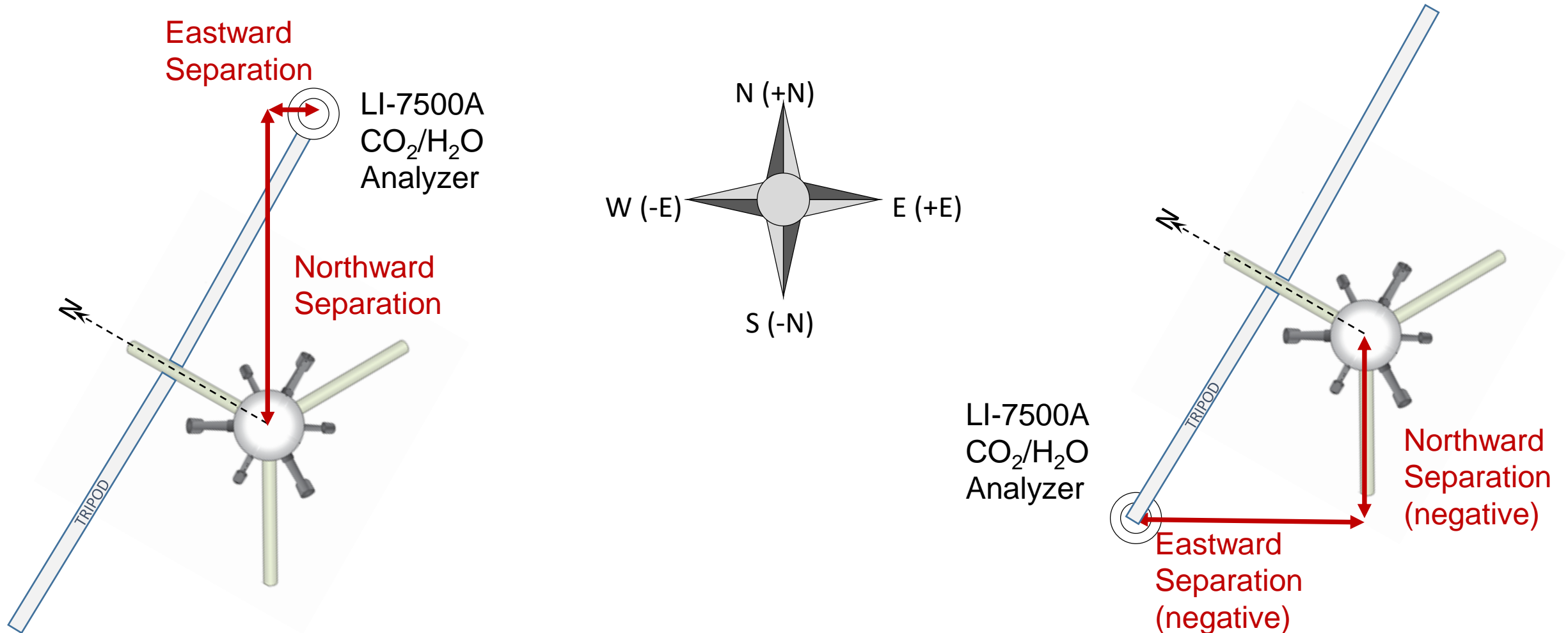
Select All | Select None | Default

Start | Stop | Eject

Size: 3.8 GB  
Free Space: 36.6 MB  
USB Status: Logging

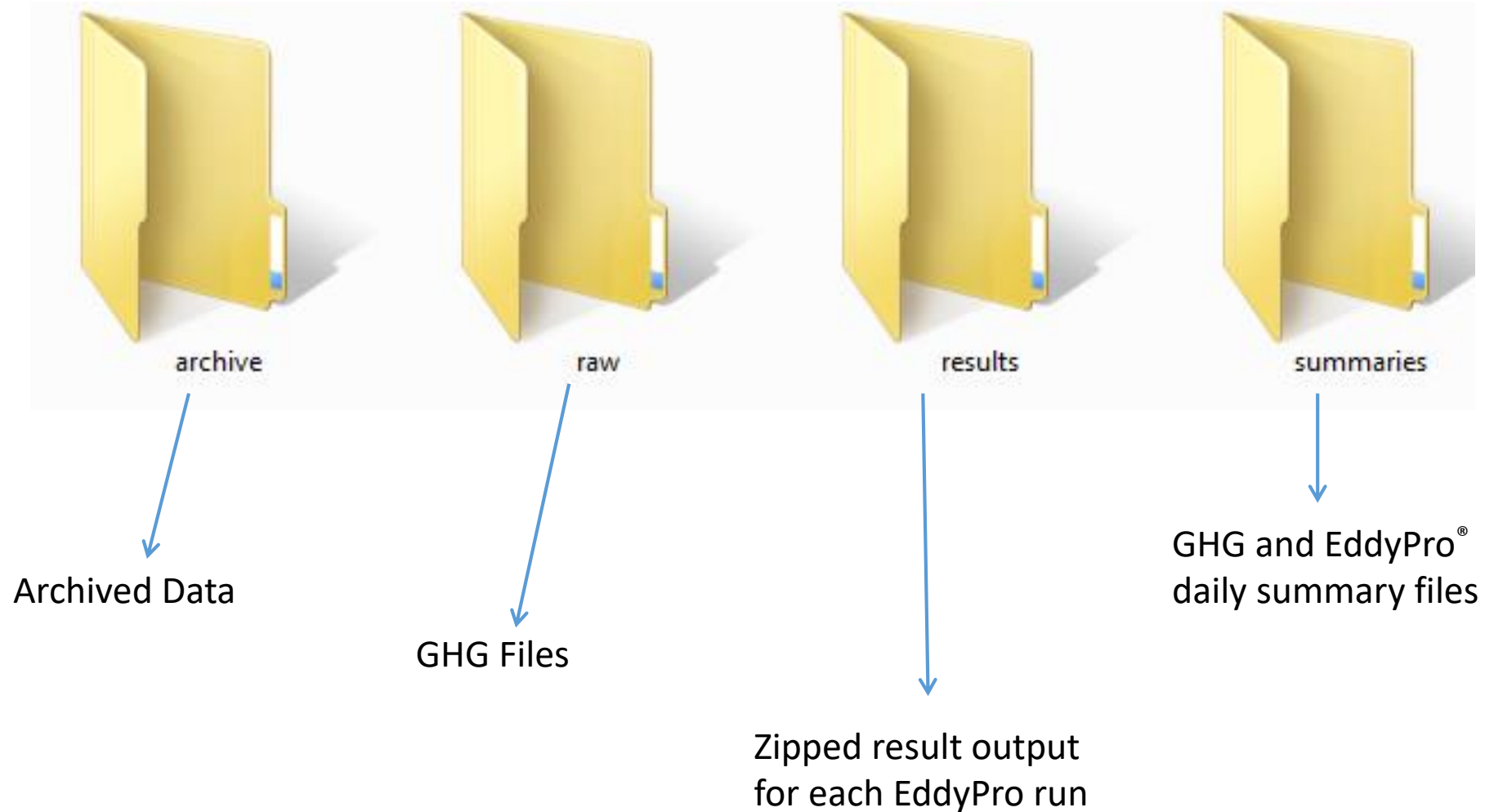
OK | Apply | Cancel

# Horizontal Separation metadata (top view)



System Data Outputs

# Files available through SMARTFlux™ equipped LI-7550



# Raw Data

EddyPro is optimized  
for LI-COR GHG data

“.ghg” files  
Raw archives containing four files

Flux data

Biomet data

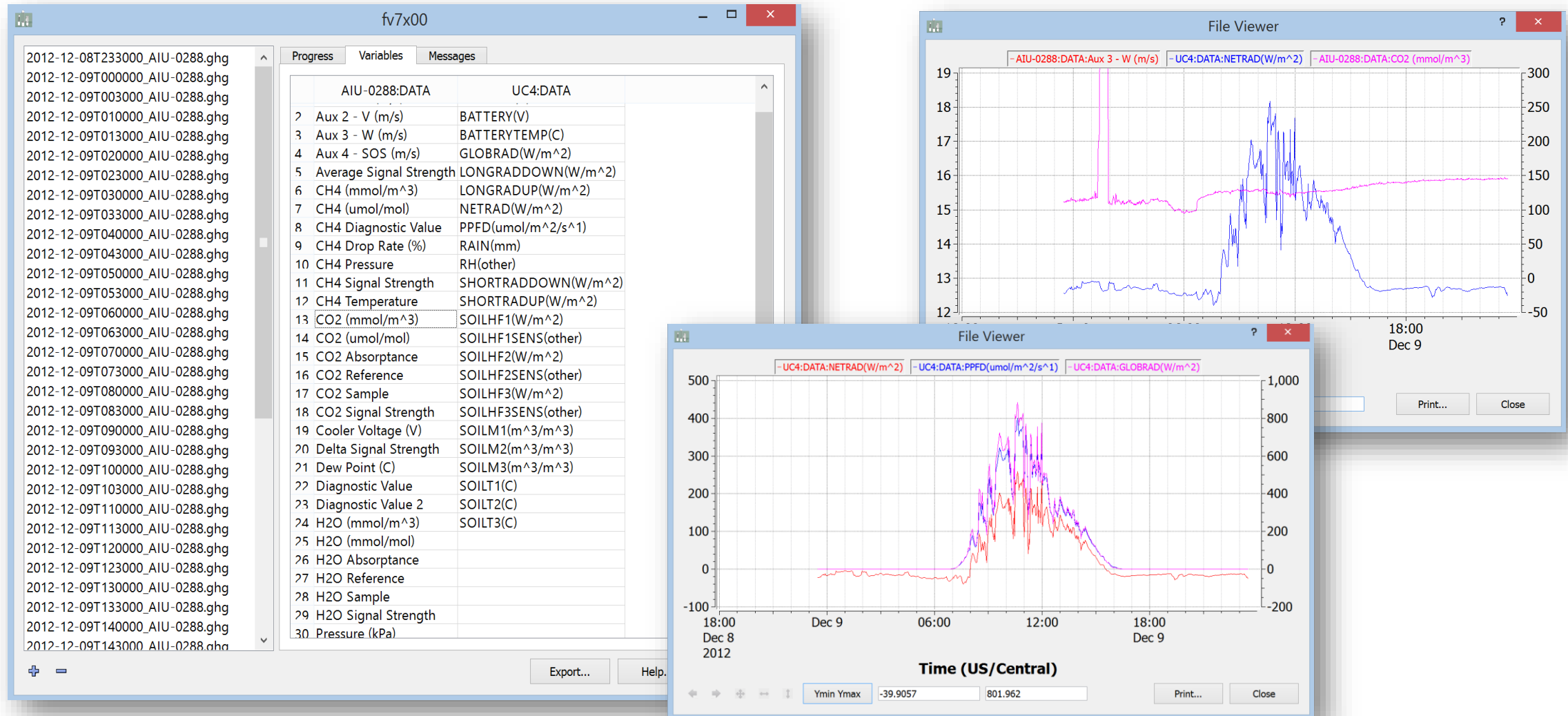
**1** High-frequency data  
wind,  
gas concentration, temperatures, etc

**2** Flux metadata  
Measurement height,  
canopy height, sensor separation, etc

**3** Low-frequency data  
Radiation,  
soil heat flux, air temperature, etc

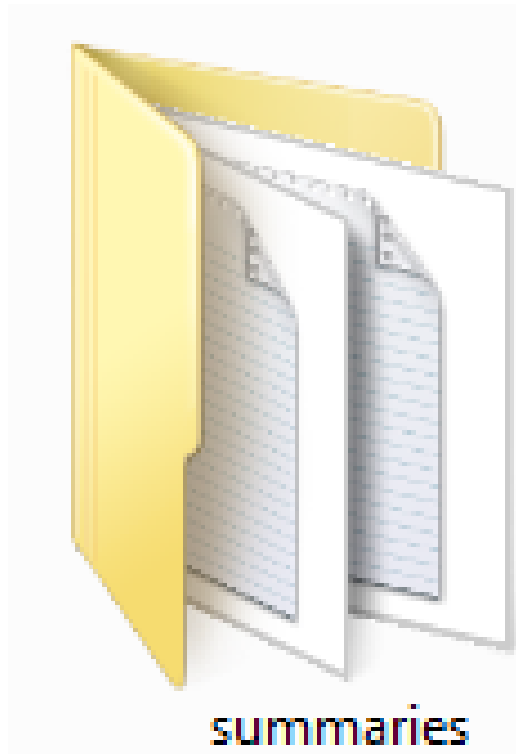
**4** Biomet metadata  
Variable names,  
units, sampling rates, etc

# Raw Data Visualization – LI-7xx File Viewer

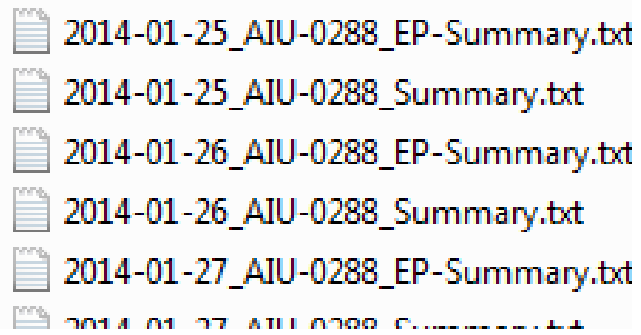




# SMARTFlux™ Outputs – Summaries Folder

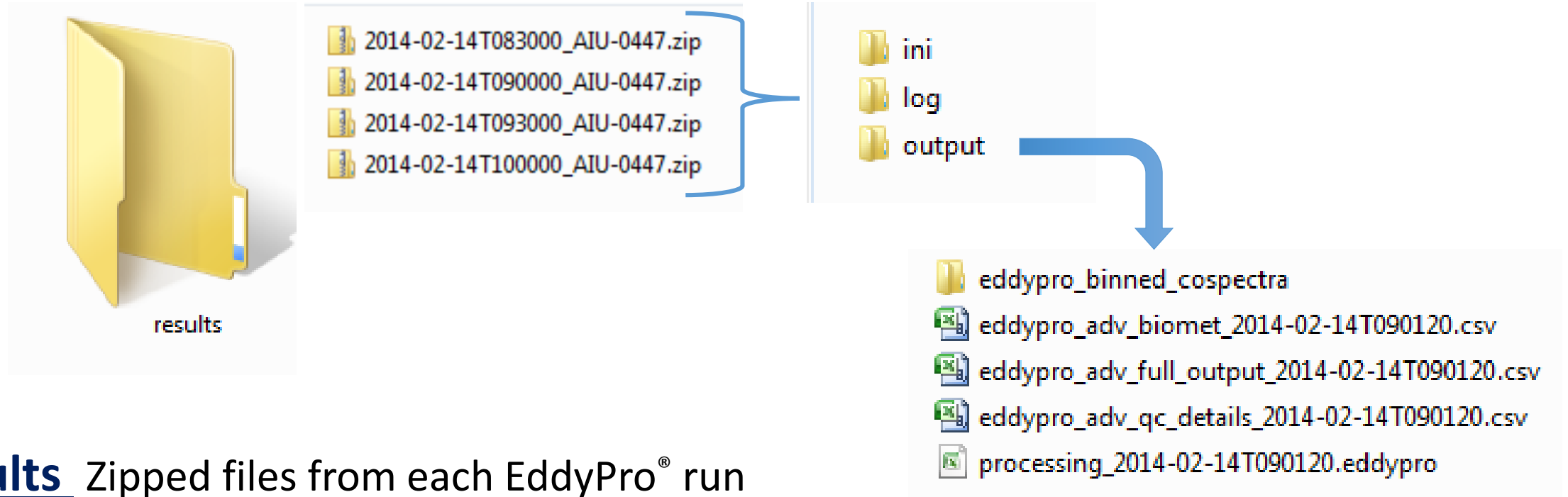


1. Final fluxes for each half hour of the day computed by SmartFlux™ (Flux Summary)
2. An average value for each half hour of the day for all variables measured by the gas analyzer (Diagnostic Summary)



2014-01-25\_AIU-0288\_EP-Summary.txt  
2014-01-25\_AIU-0288\_Summary.txt  
2014-01-26\_AIU-0288\_EP-Summary.txt  
2014-01-26\_AIU-0288\_Summary.txt  
2014-01-27\_AIU-0288\_EP-Summary.txt  
2014-01-27\_AIU-0288\_Summary.txt

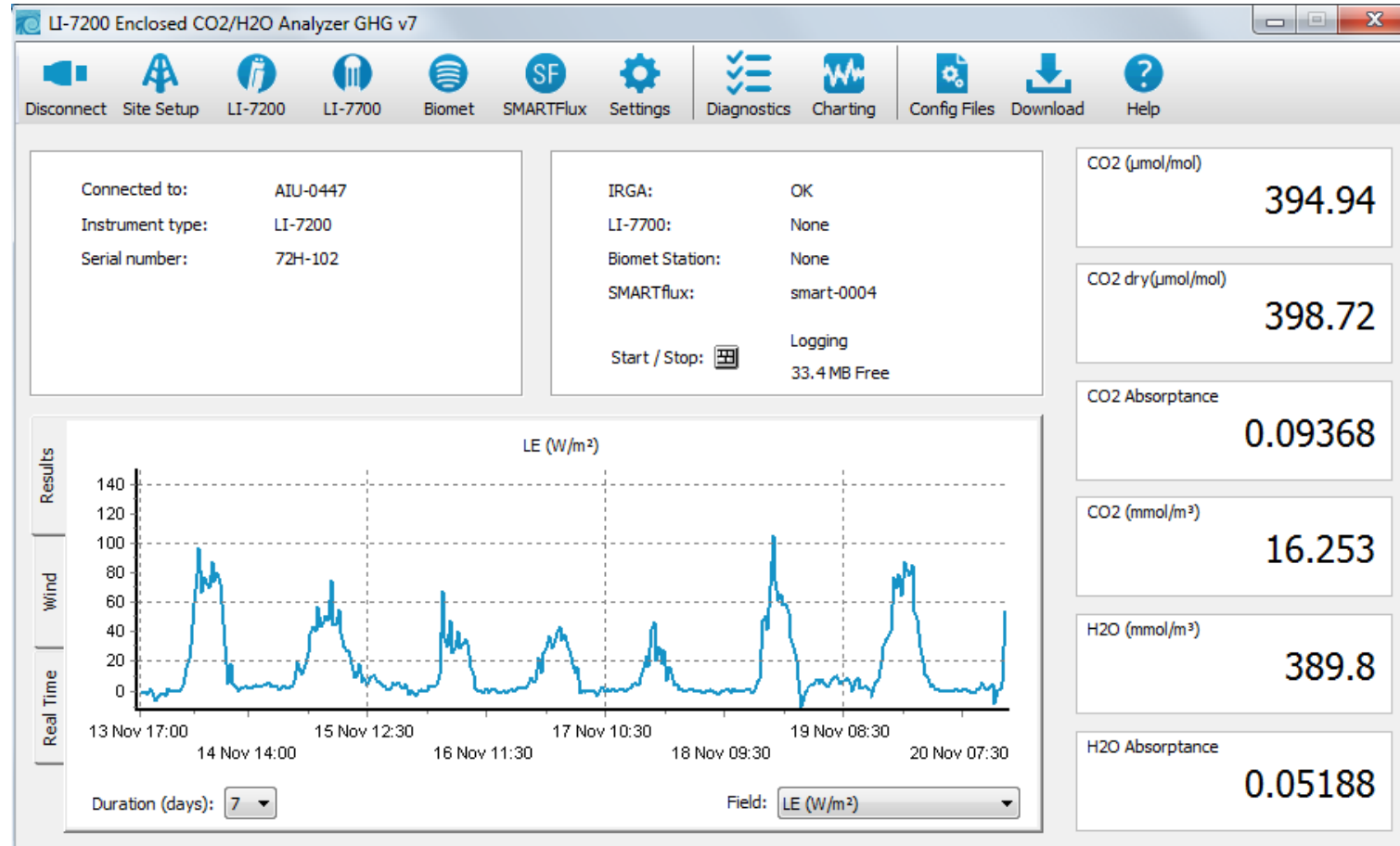
# SMARTFlux™ Outputs – Results Folder



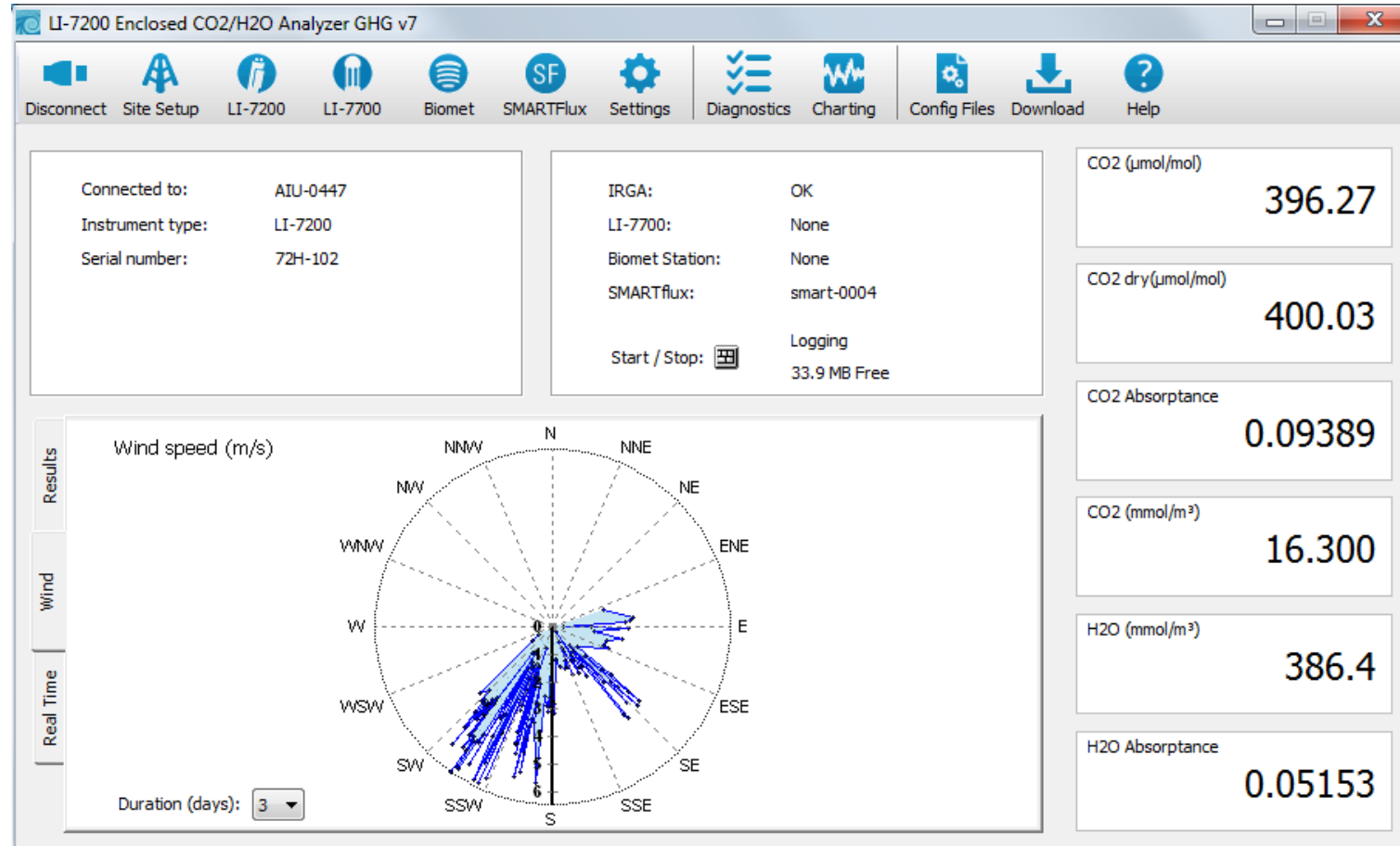
**Results** Zipped files from each EddyPro® run  
**ini folder** – Project file used to process the data  
**log** – the EddyPro® engine log for the run  
**output** – contains all requested output files

# System Monitoring

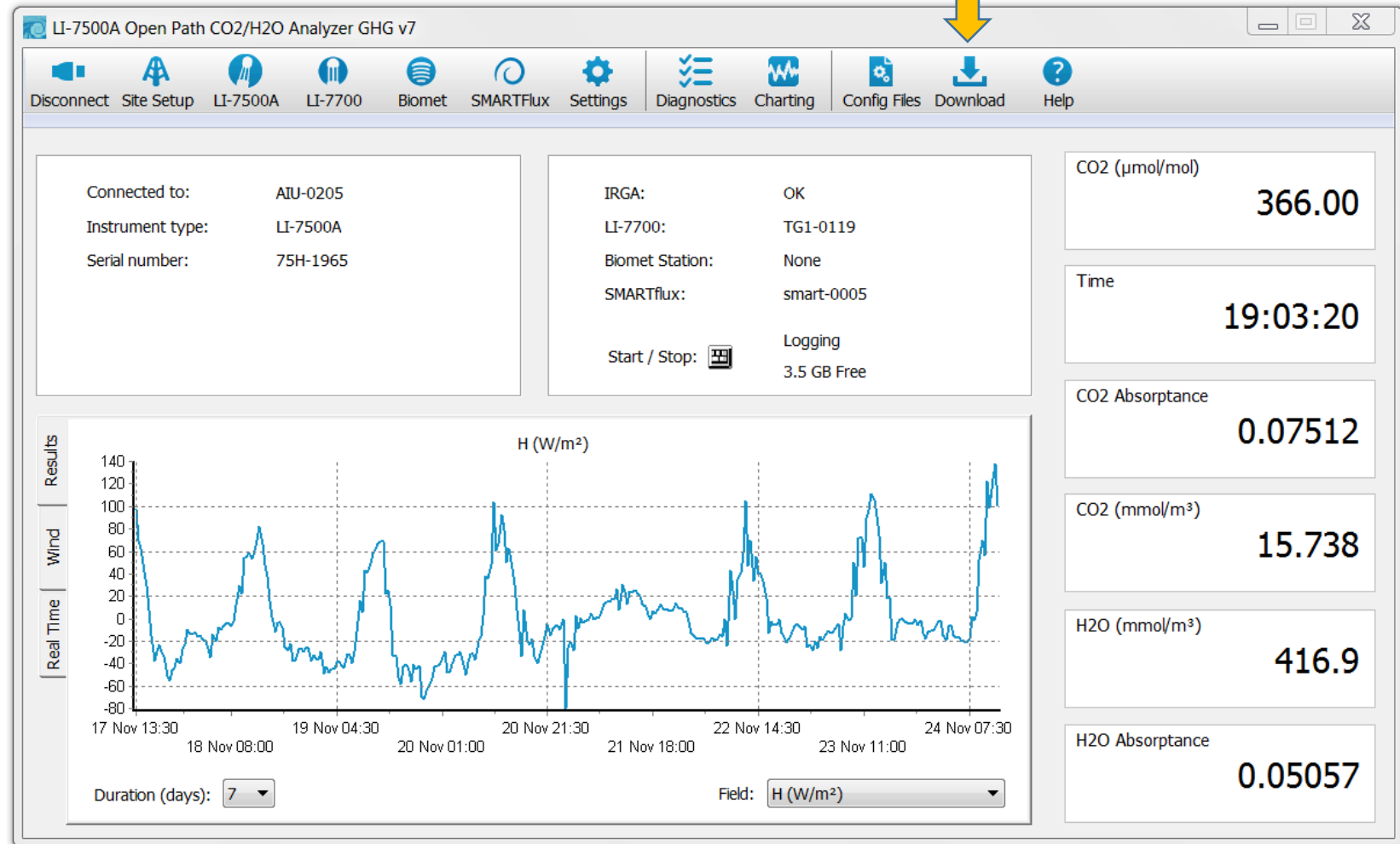
# System Monitoring



# System Monitoring

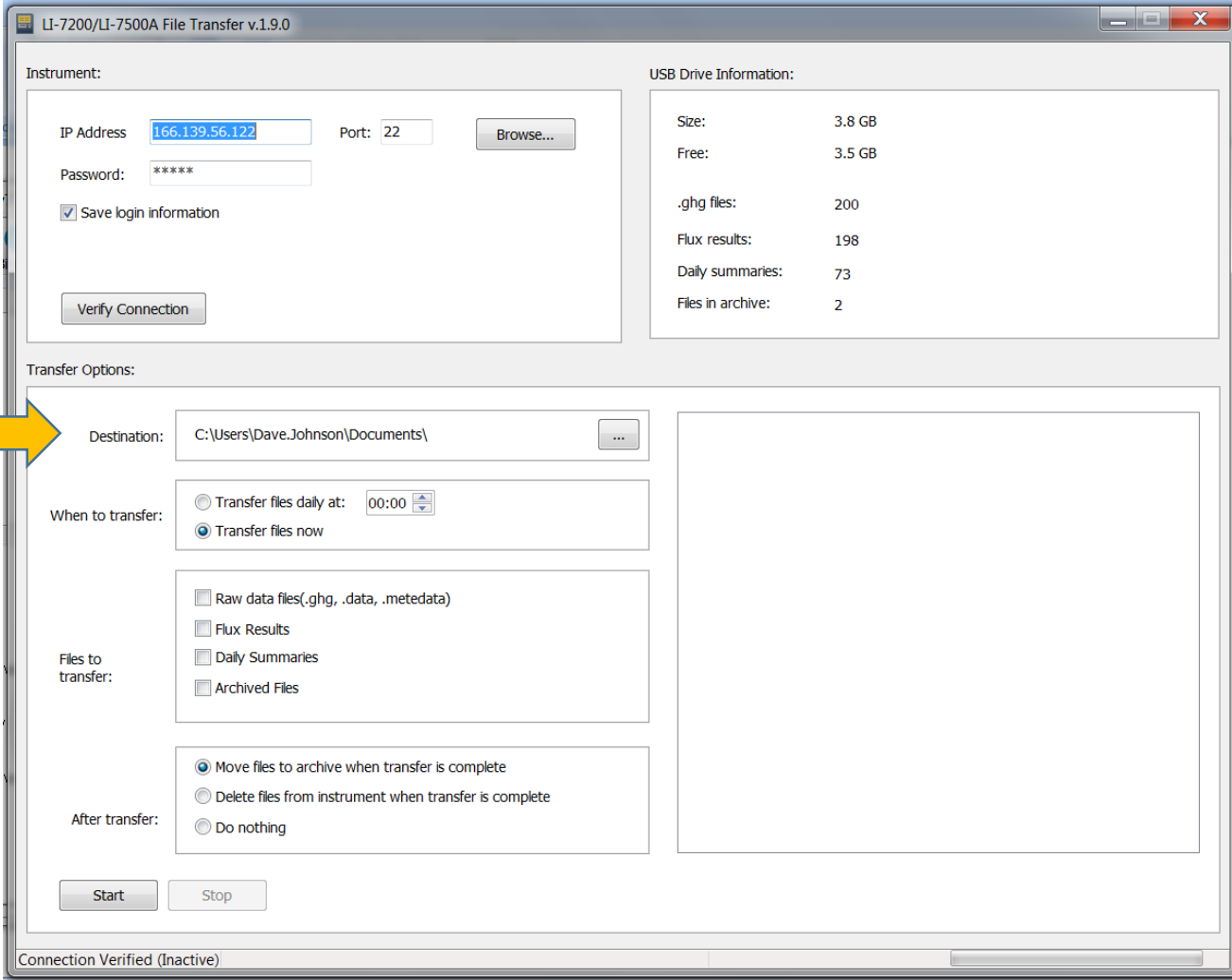


# Set-up the automatic file transfer





# Set-up the automatic file transfer



The screenshot shows the 'LI-7200/LI-7500A File Transfer v.1.9.0' window. It is divided into several sections: 'Instrument' with fields for IP Address (166.139.56.122), Port (22), Password (\*\*\*\*\*), and a 'Save login information' checkbox; 'USB Drive Information' showing drive details like Size (3.8 GB) and Free space (3.5 GB); 'Transfer Options' which includes a 'Destination' field (C:\Users\Dave.Johnson\Documents\), 'When to transfer' options (daily at 00:00 or now), 'Files to transfer' (Raw data files, Flux Results, Daily Summaries, Archived Files), and 'After transfer' options (Move files to archive, Delete files from instrument, or Do nothing). A yellow arrow points to the 'Destination' field. At the bottom, there are 'Start' and 'Stop' buttons, and a status bar indicating 'Connection Verified (Inactive)'.

LI-7200/LI-7500A File Transfer v.1.9.0

Instrument:

IP Address: 166.139.56.122 Port: 22 Browse...

Password: \*\*\*\*\*

☒ Save login information

Verify Connection

USB Drive Information:

Size: 3.8 GB

Free: 3.5 GB

.ghg files: 200

Flux results: 198

Daily summaries: 73

Files in archive: 2

Transfer Options:

Destination: C:\Users\Dave.Johnson\Documents\

When to transfer:

☐ Transfer files daily at: 00:00

☒ Transfer files now

Files to transfer:

☐ Raw data files(.ghg, .data, .metadata)

☐ Flux Results

☐ Daily Summaries

☐ Archived Files

After transfer:

☒ Move files to archive when transfer is complete

☐ Delete files from instrument when transfer is complete

☐ Do nothing

Start Stop

Connection Verified (Inactive)

# Data Transfer

LI-7200/LI-7500A File Transfer v.1.9.0

**Instrument:**

IP Address:  Port:

Password:

☒ Save login information

**USB Drive Information:**

Size: 3.8 GB  
Free: 3.5 GB  
.ghg files: 200  
Flux results: 198  
Daily summaries: 73  
Files in archive: 2

**Transfer Options:**

Destination:

When to transfer:

☐ Transfer files daily at:

☒ Transfer files now

Files to transfer:

☐ Raw data files(.ghg, .data, .metadata)

☒ Flux Results

☐ Daily Summaries

☐ Archived Files

After transfer:

☒ Move files to archive when transfer is complete

☐ Delete files from instrument when transfer is complete

☐ Do nothing

**Flux Results**

- ☒ /home/licor/data/results/2013-11-20T160000\_AIU-0205.zip
- ☒ /home/licor/data/results/2013-11-20T163000\_AIU-0205.zip
- ☒ /home/licor/data/results/2013-11-20T170000\_AIU-0205.zip
- ☒ /home/licor/data/results/2013-11-20T173000\_AIU-0205.zip
- ☒ /home/licor/data/results/2013-11-20T180000\_AIU-0205.zip
- ☒ /home/licor/data/results/2013-11-20T183000\_AIU-0205.zip
- ☒ /home/licor/data/results/2013-11-20T190000\_AIU-0205.zip
- ☒ /home/licor/data/results/2013-11-20T193000\_AIU-0205.zip
- ☒ /home/licor/data/results/2013-11-20T200000\_AIU-0205.zip
- ☒ /home/licor/data/results/2013-11-20T203000\_AIU-0205.zip
- ☒ /home/licor/data/results/2013-11-20T210000\_AIU-0205.zip
- ☒ /home/licor/data/results/2013-11-20T213000\_AIU-0205.zip
- ☒ /home/licor/data/results/2013-11-20T220000\_AIU-0205.zip
- ☒ /home/licor/data/results/2013-11-20T223000\_AIU-0205.zip
- ☒ /home/licor/data/results/2013-11-20T230000\_AIU-0205.zip
- ☒ /home/licor/data/results/2013-11-20T233000\_AIU-0205.zip
- ☒ /home/licor/data/results/2013-11-21T000000\_AIU-0205.zip
- ☒ /home/licor/data/results/2013-11-21T003000\_AIU-0205.zip
- ☒ /home/licor/data/results/2013-11-21T010000\_AIU-0205.zip
- ☒ /home/licor/data/results/2013-11-21T013000\_AIU-0205.zip

Connection Verified (Inactive)

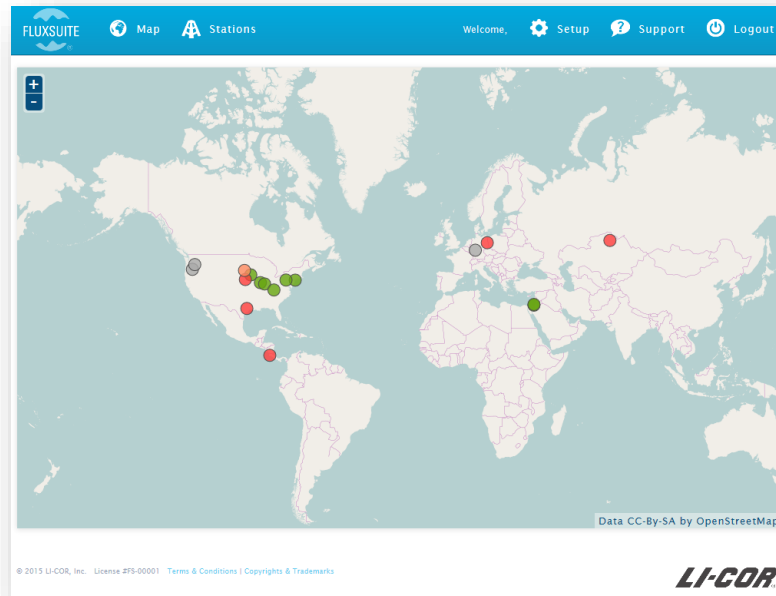
# FLUXSUITE™

A NEW TOOL FOR ACTUAL AND VIRTUAL NETWORKS OF FLUX STATIONS



# FluxSuite

- FluxSuite is a combination of hardware, software and web-service
- Modern, fast, and easy-to-use tool for station monitoring & management





Thank You  
Questions?

