A Scalable, Automated Data Pipeline and Interactive Dashboard for High-Throughput Methane Phenotyping

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ICAR 2026 | June 4th, 2026

Focus on the Upstream Process

How do we automatically and reliably get raw methane data from sniffers on dozens of remote commercial farms to a standardized central database?

From Single Farms to National Programs

Global Expansion

Started with **Lactanet** in Canada across Alberta and Quebec. Expanded to Ontario and British Columbia.

Successfully deploy for **Qualitas AG** in Switzerland, which later expanded to Austria and Germany.

Operational Logic

Deployment is location agnostic, supporting **multi-region aggregation** workflows.

Ensures data integrity and process consistency across diverse geographic locations.

Scale & Efficiency

Repeatable architecture enables rapid country-scale expansion.

Growth is achieved seamlessly **without the need for redesign** or technical debt.

Standardized workflows ensure consistency from individual data collection to national-level insights.

From Single Farms to National Programs

Canada (Lactanet)

- Started in Alberta: 10 sniffers (4 farms)
- Quebec: 25 sniffers (14 farms)
- Ontario: 14 sniffers (6 farms)
- British Columbia: 10 sniffers (2 farms)
- Holstein & Jerseys
- **Total: 59 Sniffers, ~5 partner organizations**

Switzerland (Qualitas AG)

- Nationwide Launch: 64 sniffers (57 farms)
- DACH Region: 8 rotating sniffers across Switzerland, Austria, & Germany (48 farms)
- Holstein & Brown Swiss
- **Total: 72 Sniffers, ~10 partner organizations**

Scaling international research through standardized methane data integration.

The Challenge of Distributed Phenotyping

The Need: Deploy MooLogger (Tecnosens S.P.A.) sniffers nationwide

The Goal: Turn high-frequency sensor streams into a centralized, queryable asset for geneticists

Key Infrastructure Challenges

Private Networks

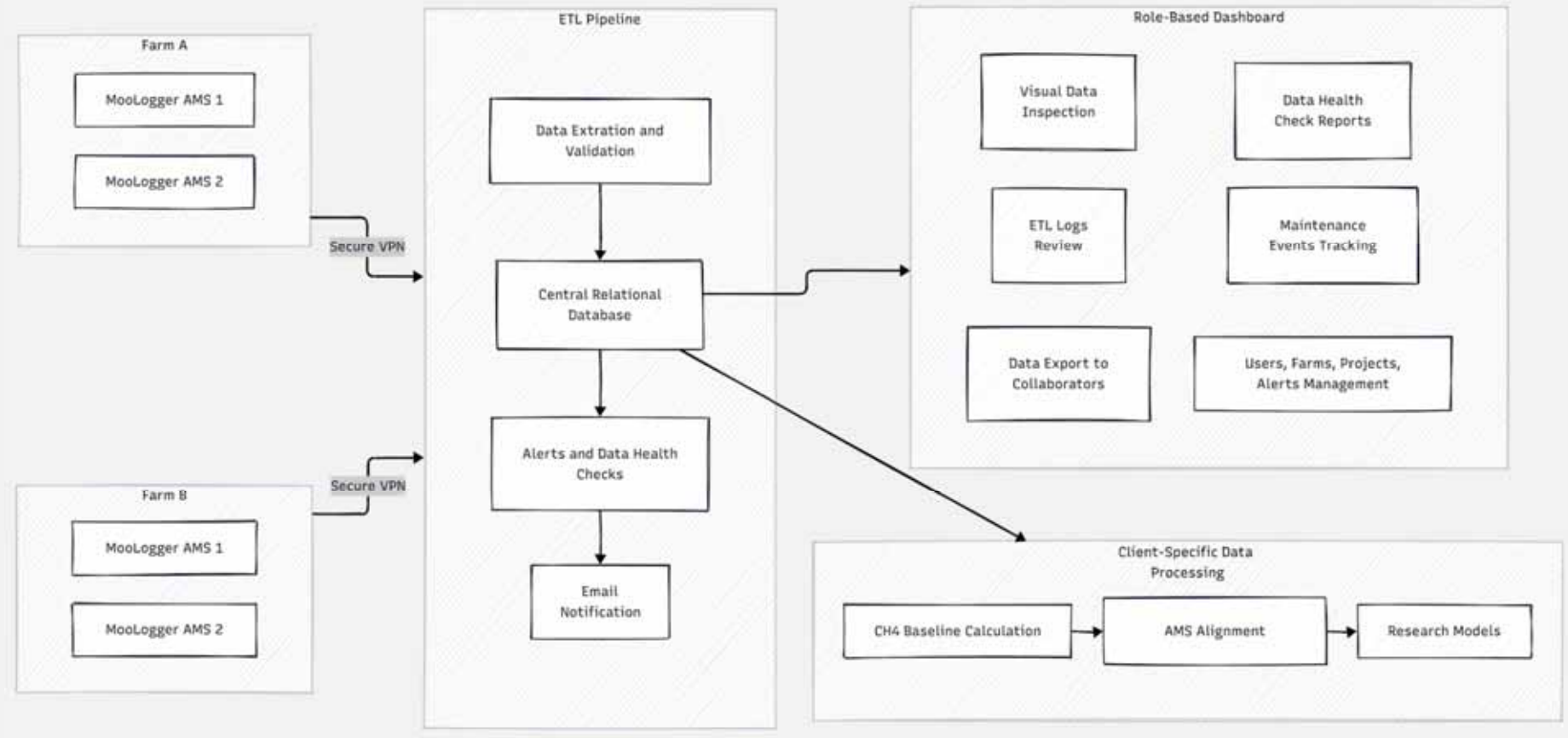
Unstable Connectivity

Power Outages

Harsh Environments

Sensor Streams: CH4, CO2, Flow, Temperature, Humidity

End-To-End Path Overview



Connectivity: Bridging the Farm-To-Cloud Gap

VPN Integration: Every sniffer is a node on a private national network.

Benefits

- No port forwarding required on farm routers.
- Static IP addresses specific to each sniffer independent from farm network.
- Secure SSH and API access for remote troubleshooting and data collection.

Uptime Monitoring

- Real-time ICMP ping
- API health checks integrated into the management layer

The ETL Engine: Built for Reliability

Dual-Path Ingestion

Early versions (MooLogger):
Direct PostgreSQL extraction

Current versions (MooLogger Plus):
Pulling data via MooLogger API

Fault Tolerance

Auto-Catchup:
System tracks "last extracted date" per sniffer.

Exactly-Once Semantics:
Prevention of duplicate records during reconnection bursts.

Batch Processing:
Concurrent extraction threads to handle dozens of devices simultaneously.

Preventing Silent Failures Before Analysis

Activity Monitoring

Checks for recording activity verify reachability, freshness, and growth behavior.

Daily summaries and periodic status check throughout the day balance broad review and rapid response.

Advanced Alert Logic

Absolute-value alerts use banded ranges for CH4, CO2, airflow, temperature, and humidity.

Percent-change alerts detect sniffer-specific changes againts their own rolling baseline.

Triage & Severity Protocol

Standardized severity levels support practical triage and operational focus:

SUCCESS WARNING ERROR CRITICAL

Management at Multi-Institution Scale

Access & Permissions

Role-based access controls who sees and receives which data, and who can add/edit events.

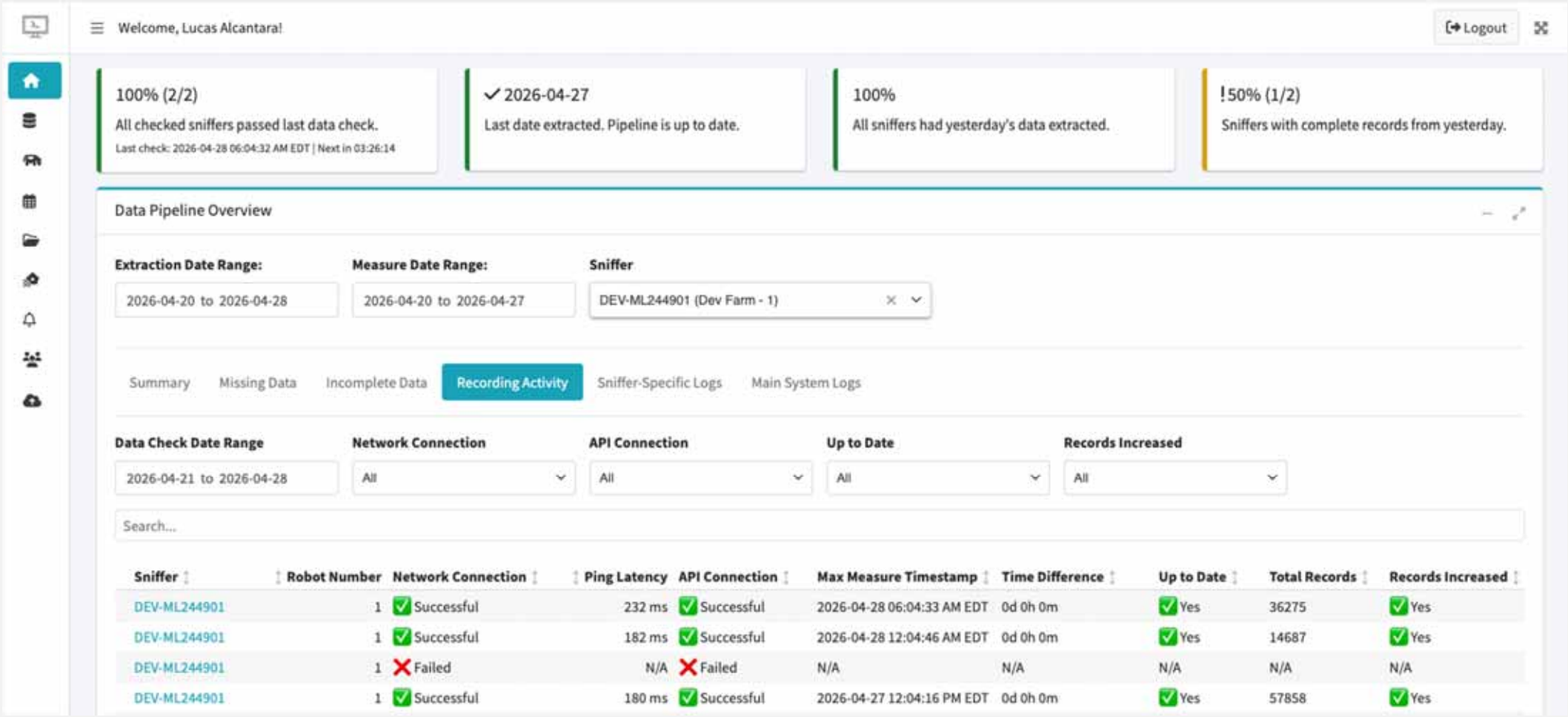
Technical support can have access but does not receive alert notifications.

Project-Level Scoping

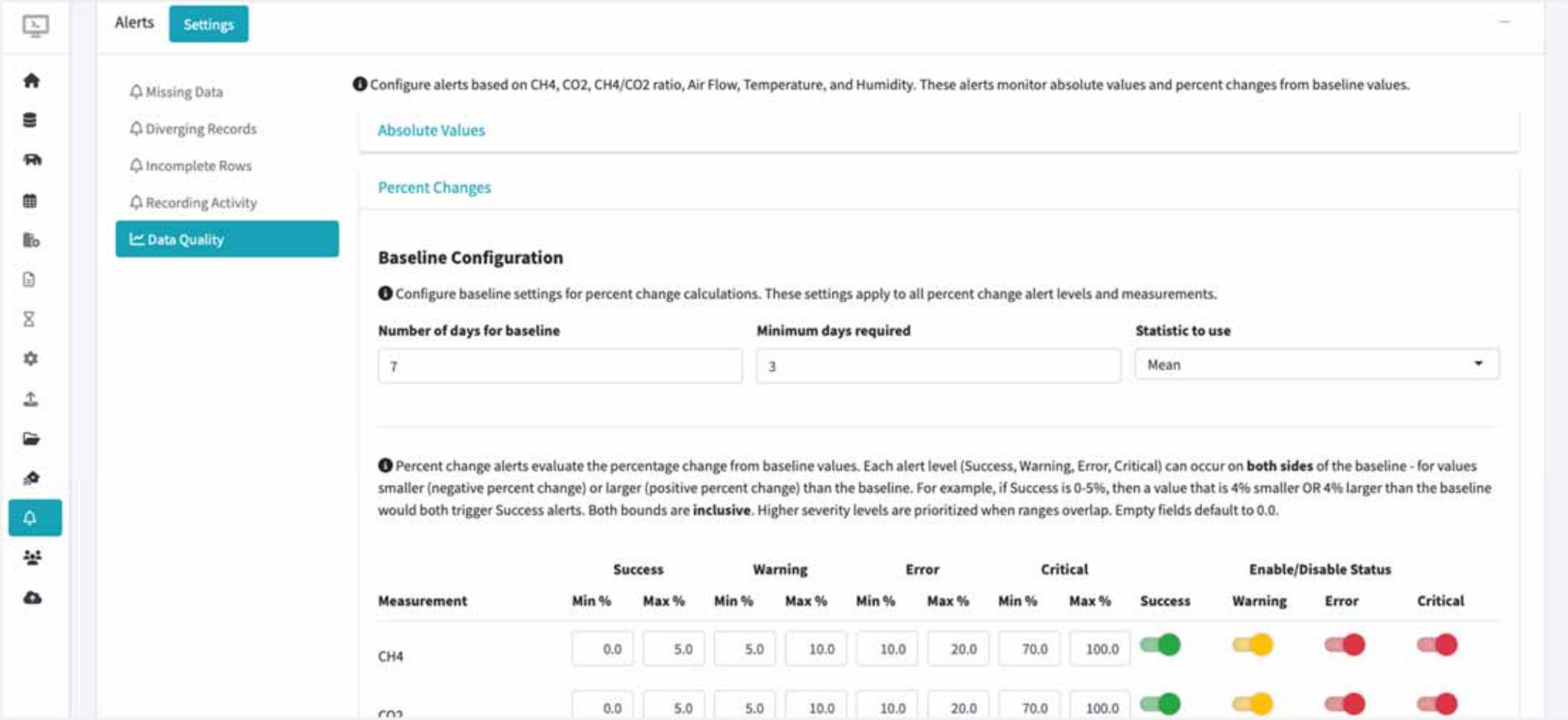
Project-level scoping keeps notifications relevant and reduces alert fatigue by narrowing the operational field.

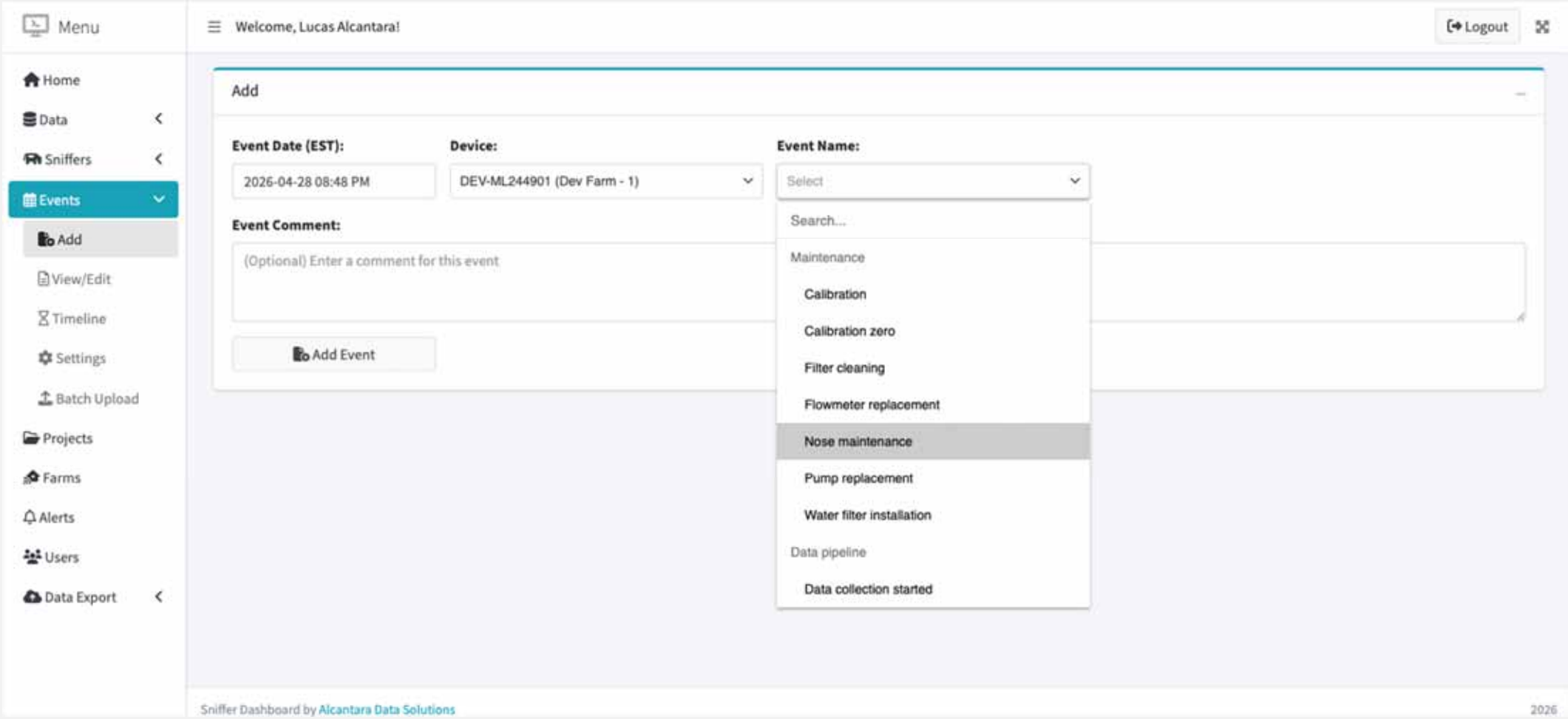
Institutional Governance

Governance supports clean boundaries across institutions and funded projects, ensuring operational independence while maintaining centralized oversight capabilities.


Welcome, Lucas Alcantara!
Logout
100% (2/2)
All checked sniffers passed last data check.
Last check: 2026-04-28 06:04:32 AM EDT | Next in 03:26:14
✓ 2026-04-27
Last date extracted. Pipeline is up to date.
100%
All sniffers had yesterday's data extracted.
!50% (1/2)
Sniffers with complete records from yesterday.
Data Pipeline Overview
Extraction Date Range:
2026-04-20 to 2026-04-28
Measure Date Range:
2026-04-20 to 2026-04-27
Sniffer
DEV-ML244901 (Dev Farm - 1)
Summary
Missing Data
Incomplete Data
Recording Activity
Sniffer-Specific Logs
Main System Logs
Data Check Date Range
2026-04-21 to 2026-04-28
Network Connection
All
API Connection
All
Up to Date
All
Records Increased
All
Search...
Sniffer
Robot Number
Network Connection
Ping Latency
API Connection
Max Measure Timestamp
Time Difference
Up to Date
Total Records
Records Increased
DEV-ML244901 1 Successful 232 ms Successful 2026-04-28 06:04:33 AM EDT 0d 0h 0m Yes 36275 Yes
DEV-ML244901 1 Successful 182 ms Successful 2026-04-28 12:04:46 AM EDT 0d 0h 0m Yes 14687 Yes
DEV-ML244901 1 Failed N/A Failed N/A N/A N/A N/A N/A
DEV-ML244901 1 Successful 180 ms Successful 2026-04-27 12:04:16 PM EDT 0d 0h 0m Yes 57858 Yes


Menu
Home
Data
Explore
Download
Sniffers
Events
Projects
Farms
Alerts
Users
Data Export
Date Range:
2026-04-27 to 2026-04-27
Sniffer:
DEV-ML244901 (Dev Farm - 1)
Generate Plot
DEV-ML244901 (Dev Farm - 1)
CO2 & CH4 (ppm)
FLOW (L/min)
Measure
FLOW
CO2
CH4
20k
15k
10k
5k
0
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
00:00
Apr 27, 2026
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Apr 28, 2026
Timestamp (UTC)


Alerts
Settings
Missing Data
Diverging Records
Incomplete Rows
Recording Activity
Data Quality
Configure alerts based on CH4, CO2, CH4/CO2 ratio, Air Flow, Temperature, and Humidity. These alerts monitor absolute values and percent changes from baseline values.
Absolute Values
Percent Changes
Baseline Configuration
Configure baseline settings for percent change calculations. These settings apply to all percent change alert levels and measurements.
Number of days for baseline
7
Minimum days required
3
Statistic to use
Mean
Percent change alerts evaluate the percentage change from baseline values. Each alert level (Success, Warning, Error, Critical) can occur on both sides of the baseline - for values smaller (negative percent change) or larger (positive percent change) than the baseline. For example, if Success is 0-5%, then a value that is 4% smaller OR 4% larger than the baseline would both trigger Success alerts. Both bounds are inclusive. Higher severity levels are prioritized when ranges overlap. Empty fields default to 0.0.
Success
Warning
Error
Critical
Enable/Disable Status
Measurement
Min %
Max %
Min %
Max %
Min %
Max %
Min %
Max %
Success
Warning
Error
Critical
CH4
0.0
5.0
5.0
10.0
10.0
20.0
70.0
100.0
CO2
0.0
5.0
5.0
10.0
10.0
20.0
70.0
100.0


Menu
Welcome, Lucas Alcantara!
Logout
Home
Data
Sniffers
Events
Add
View/Edit
Timeline
Settings
Batch Upload
Projects
Farms
Alerts
Users
Data Export
Add
Event Date (EST):
2026-04-28 08:48 PM
Device:
DEV-ML244901 (Dev Farm - 1)
Event Name:
Select
Search...
Maintenance
Calibration
Calibration zero
Filter cleaning
Flowmeter replacement
Nose maintenance
Pump replacement
Water filter installation
Data pipeline
Data collection started
Event Comment:
(Optional) Enter a comment for this event
Add Event
Sniffer Dashboard by Alcantara Data Solutions
2026

Upstream Robustness Improves Downstream Processing

Faster Detection

Faster issue detection reduces risk of losing data due to bad quality.

Routine Checks

Issues detected during routine checks can be flagged as an event and accounted for during analysis.

Immediate Alerts

Alert notifications throughout the day can be the difference between one hour or one day data lost.

Proactive monitoring ensures data integrity and minimizes impact on downstream analytical workflows.

Acknowledgements

Thank you!
Questions?

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