Bioindustry4.0

Advanced digital solutions for biomanufacturing

STAMM

Soft sensor moniToring and mAintenance framework for Machine learning Models

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INRAE

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The numbers we really need come from the lab, hours later.

- Probes measure pH, oxygen, temperature and off-gas every second
- Biomass, product, cell viability need a sample taken offline
- Offline measurements are obtained hours or days later
- **How can we estimate an offline measurement in real time?**

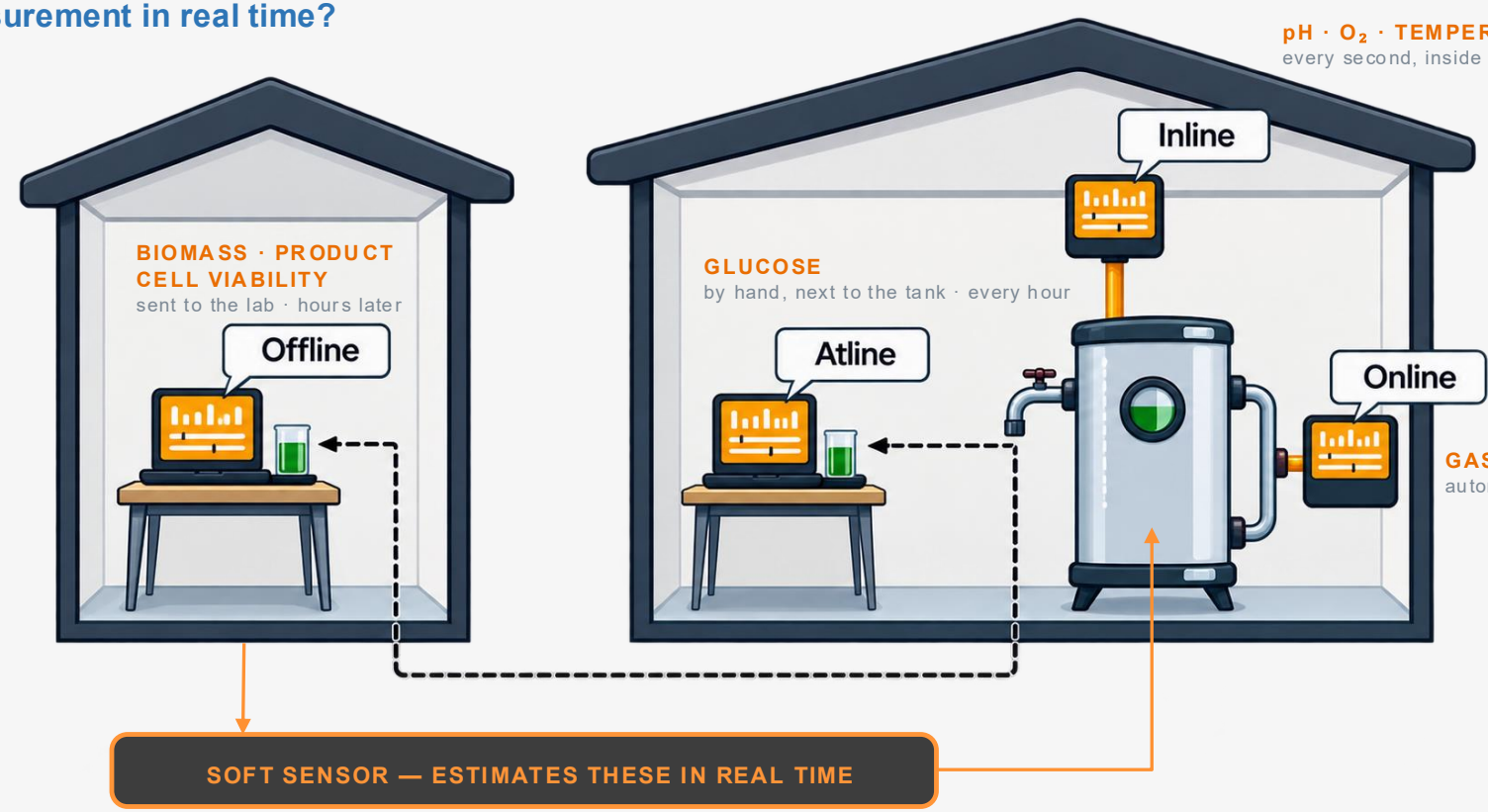
WHAT YOU ACTUALLY NEED TO KNOW IN REAL TIME

BIOMASS
how much cell mass

PRODUCT CONCENTRATION
how much product has formed

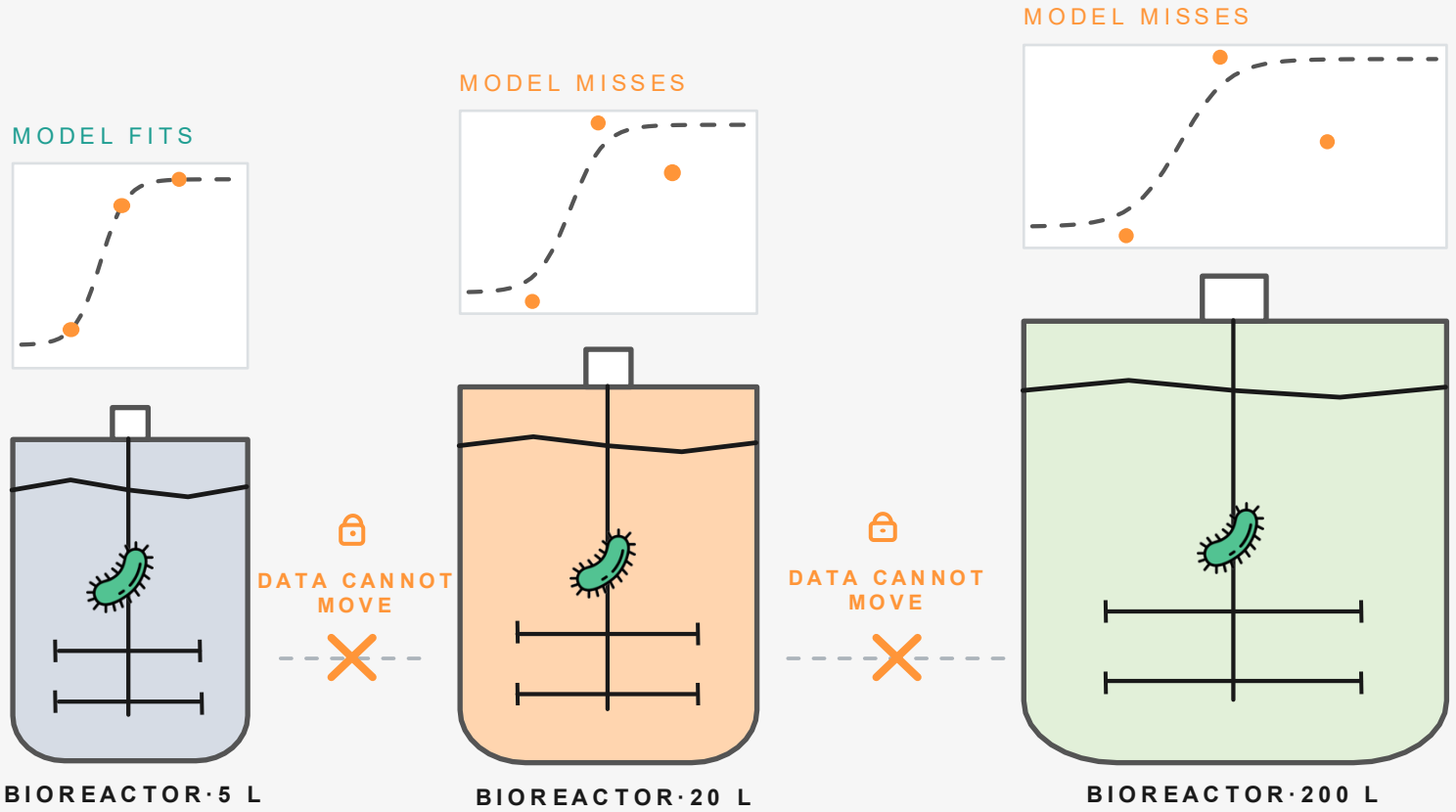
CELL VIABILITY
how many cells are alive

GLUCOSE CONCENTRATION
how much food is left



1 A model that fits your tank fits only your tank.

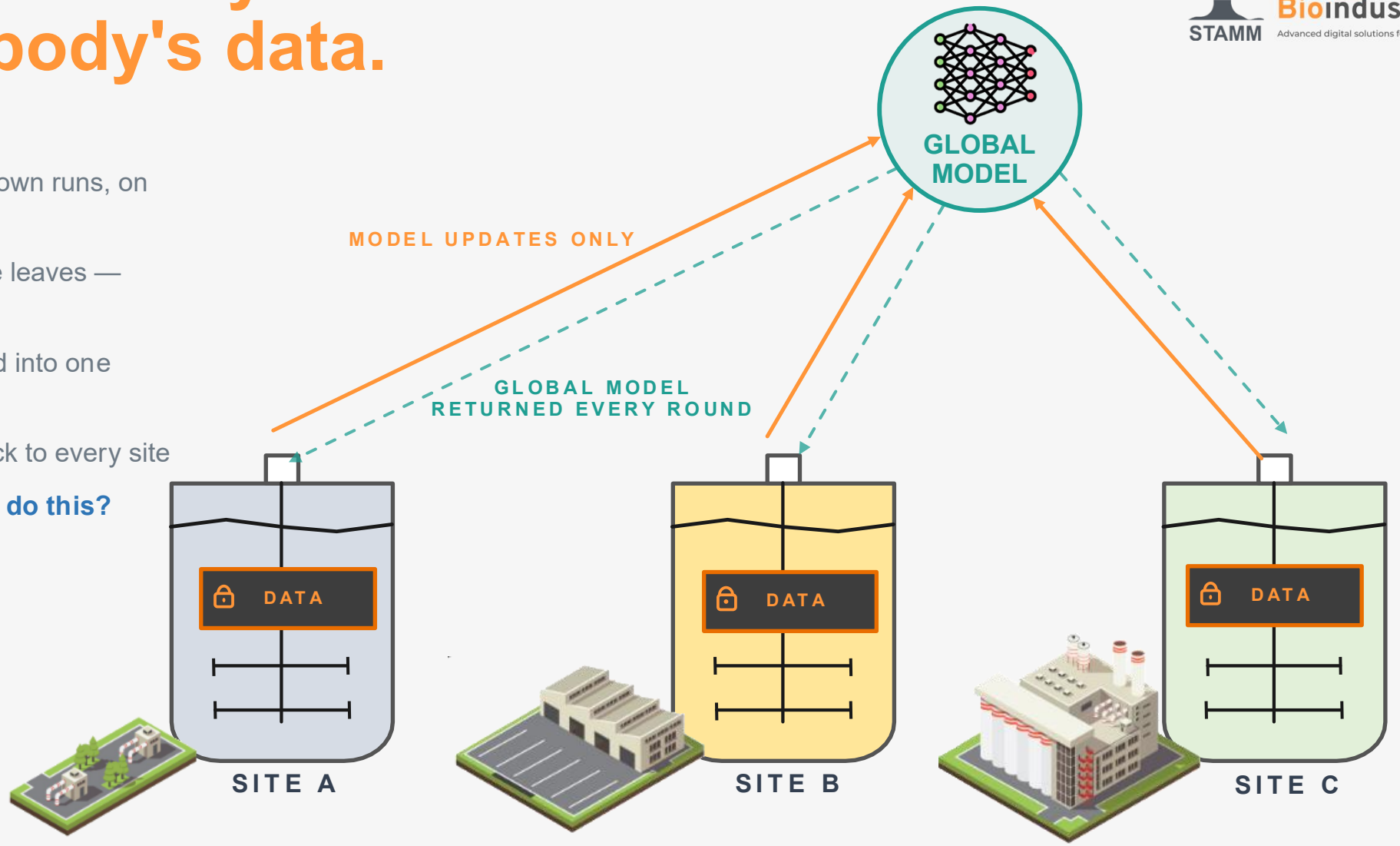
- Each site has few runs: one strain, one scale, one tank
- **More data would fix it — but process data cannot leave the plant.**
- Two ways out: reuse a model that already exists, or train together
- Both need one place where the models are kept
- **Model details**: inputs, outputs, training data, valid ranges, etc.



2

Learn from everyone's data. Move nobody's data.

- Each site trains on its own runs, on its own machines
- Only the model update leaves — never a measurement
- The updates are joined into one shared model
- That model comes back to every site
- **Is there a platform to do this?**



ONLY MODEL NUMBERS CROSS THE LINE

3

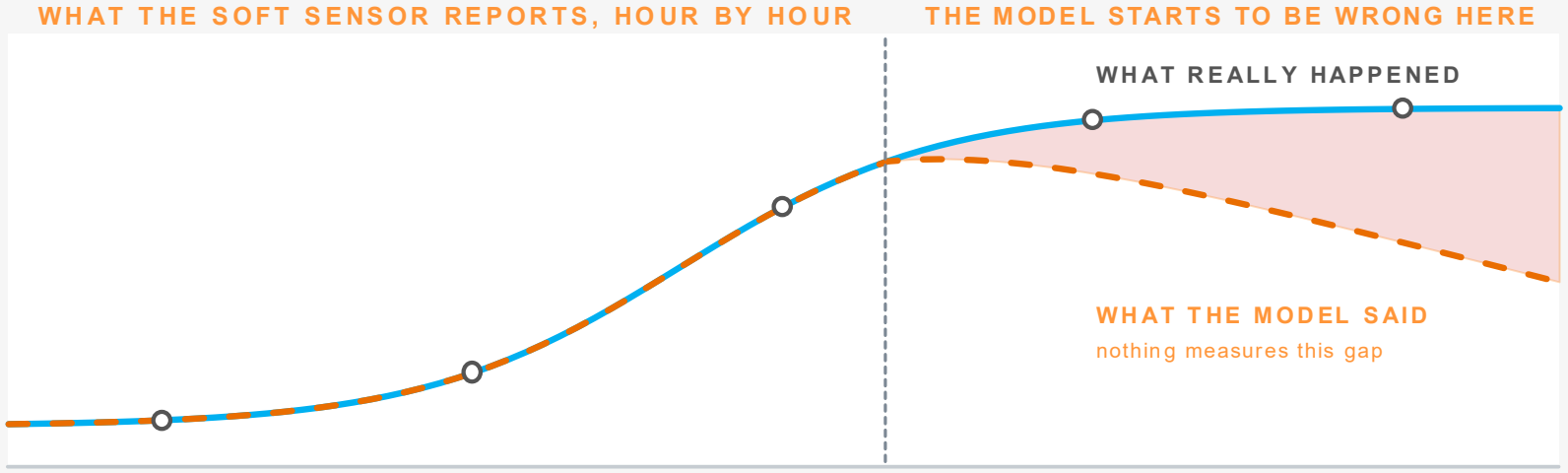
A soft sensor can be wrong and still look normal.

- The model keeps giving a number every second — it never stops by itself
- Nothing on the plant tells you that the number has become wrong
- And the process does change: new strain, new medium, a cleaned probe, sensor failures
- **A soft sensor can be wrong and still look normal.**

ON THE PLANT: ALL NORMAL

- pH — in range ✓
- DISSOLVED O_2 — in range ✓
- TEMPERATURE — in range ✓
- SOFT SENSOR — running ✓

no alarm · no red light · no warning



The numbers keep arriving. They just stop being right.

STAMM answers the three of them.

Three problems, the modules that answer them, and who uses each one.

1

MEASURE

A model that fits your tank fits only your tank.

few runs, one strain, one scale — and the data cannot leave the plant

→

MODEL REGISTRY

Every model and every version in one place: what it was trained on, its inputs and units, and the model files.

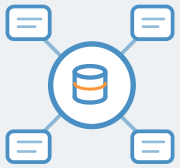
2

SHARE

Learn from everyone's data. Move nobody's data.

the model has to be built without moving a single measurement

→



THE MODEL REGISTRY AS A HUB

One place where many sites meet: each keeps its own data, and the registry holds the models, the rounds and who contributed.

3

TRUST

A soft sensor can be wrong and still look normal.

nothing on the plant tells you the number has stopped being right

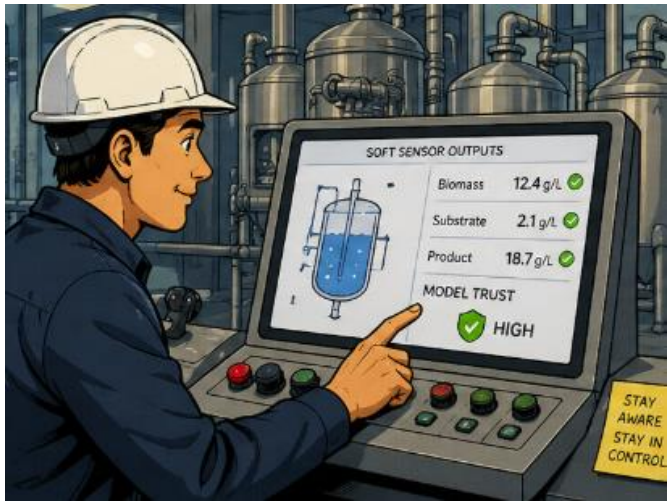
→

DRIFT DETECTORS
FERMOPS DASHBOARD

The detectors watch the inputs; the dashboard shows it where the operator already looks.

Who are the target users of STAMM?

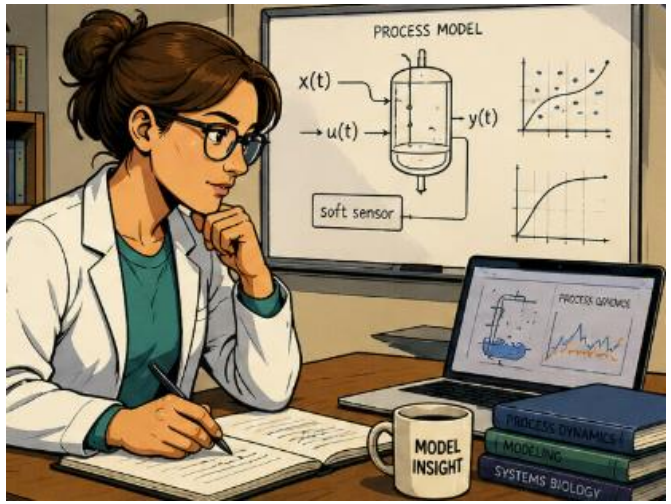
One platform, three jobs.



PROCESS USERS · CONTROL ROOM

Operators

Frontline users who run the process in real time. They act on soft sensor outputs every day and need a clear, immediate signal of trust — not statistics, but "is this number safe to act on right now?"



MODELLERS · PROCESS ENGINEERING

Process modellers

Process engineers who design and validate soft sensors, mechanistic or hybrid. They make sure predictions stay physically and biologically meaningful as the operating conditions change.

ML & DATA · MLOPS

ML engineers

MLOps specialists who deploy, monitor and maintain soft sensors in production: pipelines, versioning and retraining, so the models keep working as data and processes change underneath them.

Model Registry

SEE IT RUNNING

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Model Registry

engineer@stamm.local.com
SUPER ADMIN

MODELS
- ML Soft Sensors
- Dynamic Models
- Drift Detectors

LEARNING
- Federated Learning
- Reinforcement Learning

ADMINISTRATION
- Admin

SUPPORT
- Help

INRAE tbi
Mathematics cell

Logout

ML Soft Sensors

Browse the projects you have access to and manage their registered models.

2 projects

Export metadata

PROJECT SELECTION

PROJECT

IndPenSim

+ Add Project

REGISTERED MODELS Manage the models for the selected project.

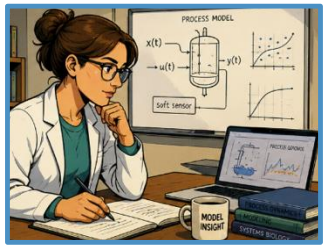
+ Add Model

Available actions: **Register to IBISBA**, **Explainability (XAI)**, **Details**, **Edit**, **Delete**.

MODEL	AUTHOR	CREATED ON	VERSION	REGISTER ...	STATUS	XAI	DET...	DOWNLOAD	EDIT	DEL...
SVM - 0007_python_p...	Suarez, C., Astudillo A.,...	26-02-2025	V.1.0		Online					
GBM - 0008_python_p...	Suarez, C., Astudillo A.,...	17-02-2025	V.1.0		Online					
LSTM - 0009_python_p...	Suarez, C., Astudillo A.,...	17-02-2025	V.1.0		Online					
GBM - 0010_python_p...	Suarez, C., Astudillo A.,...	17-02-2025	V.2.0		Online					
Biomass soft sensor (fe...		01-07-2026	1.0.0		Online					
Penicillin yield (federat...		01-07-2026	1.0.0		Online					
random_forest - 0002_...	Acosta-Pavas, J. C., Ro...	24-01-2022	V.1.0		Online					
0007_[python]_penicilli...	Ding Chang	25-08-2026	1.0.0		Online					

WHO USES THIS SCREEN

OPERATORS

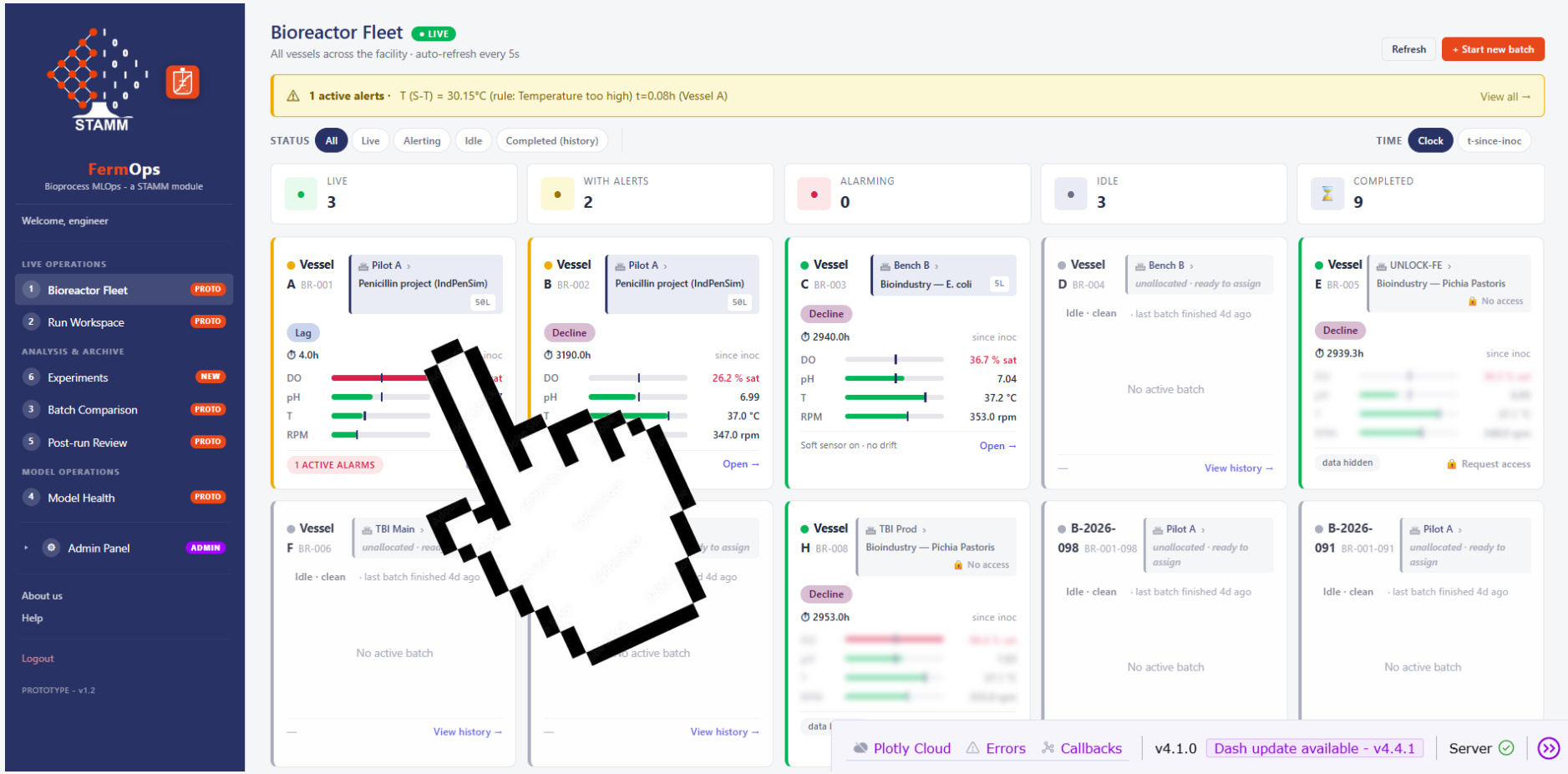


MODELLERS

ML ENGINEERS

FermOps dashboard

BIOREACTOR FLEET · RUN WORKSPACE · BATCH COMPARISON · POST-RUN REVIEW · MODEL HEALTH



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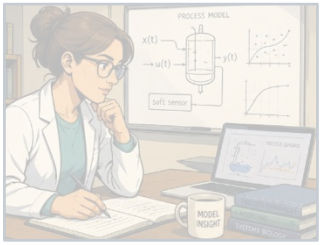
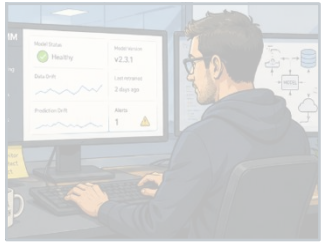


MODELLERS



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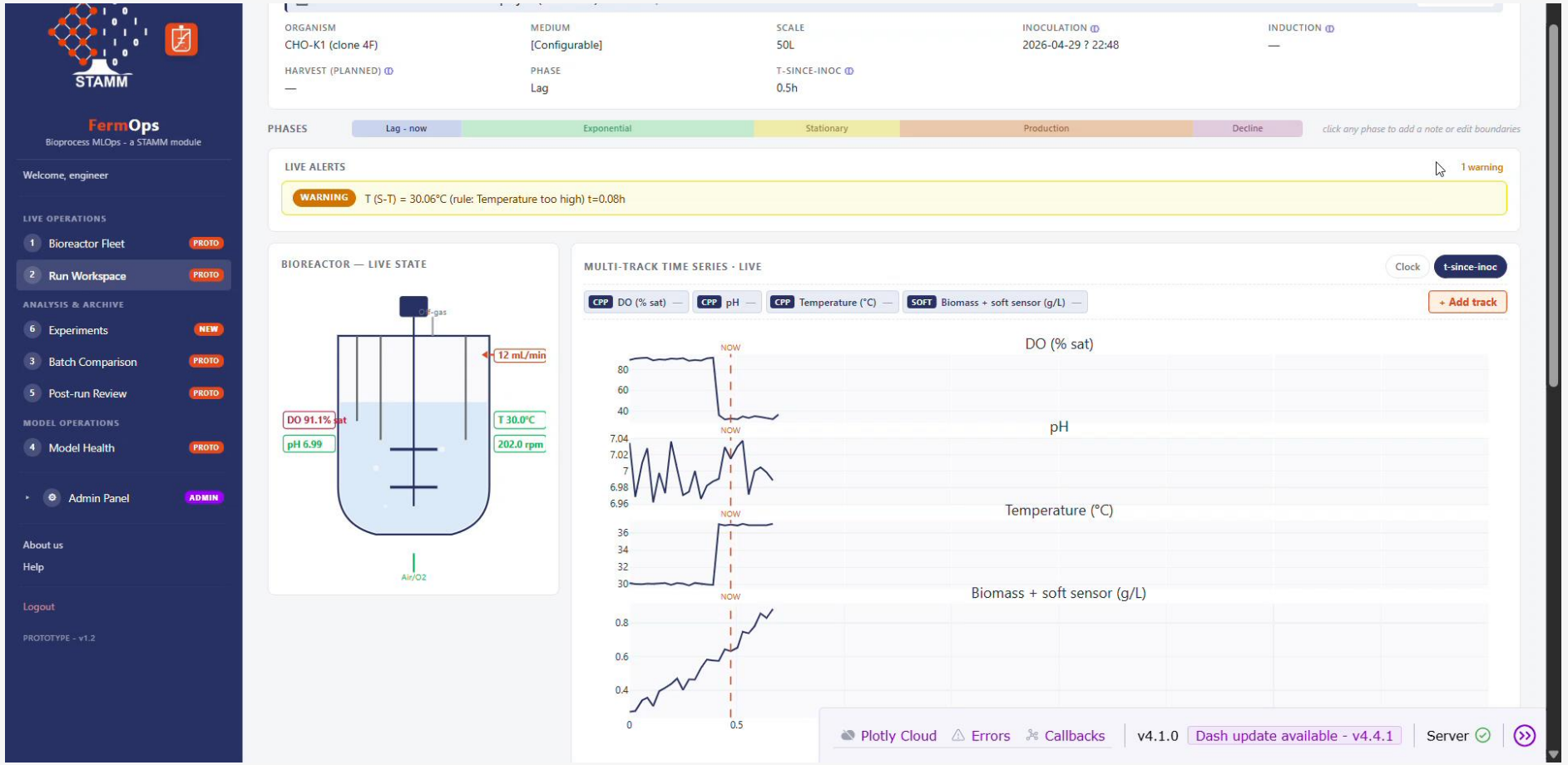

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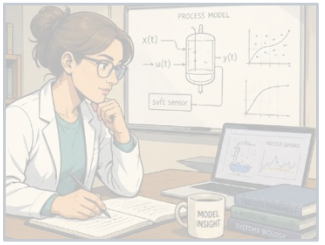

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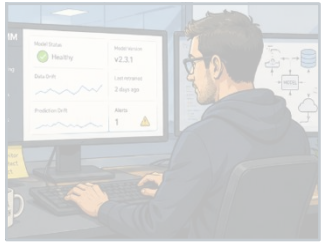

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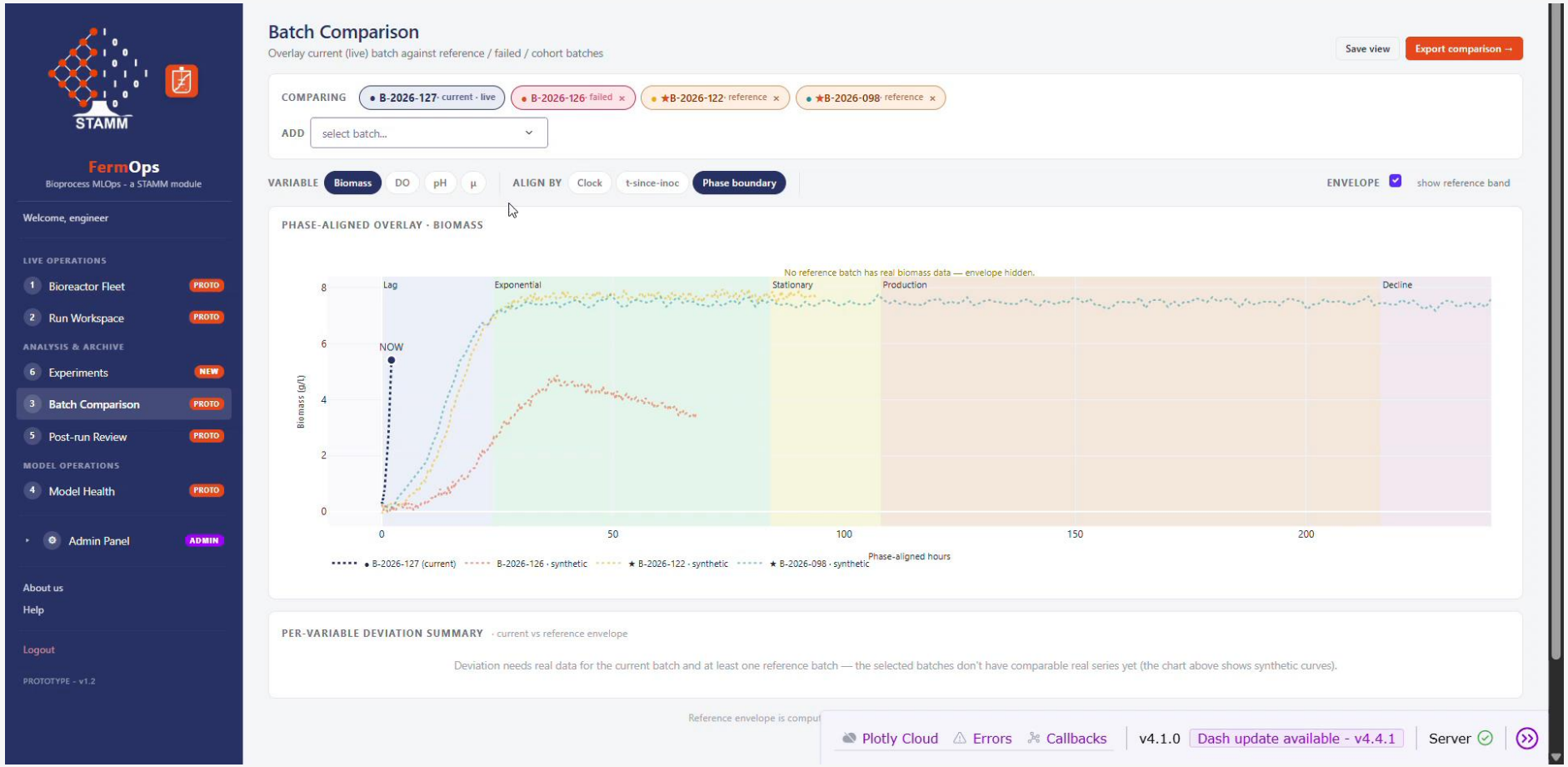

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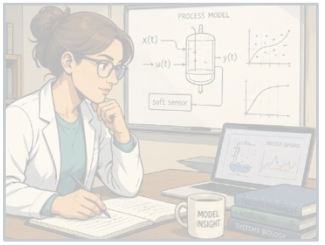

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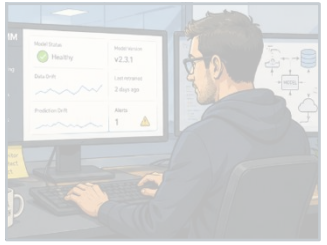

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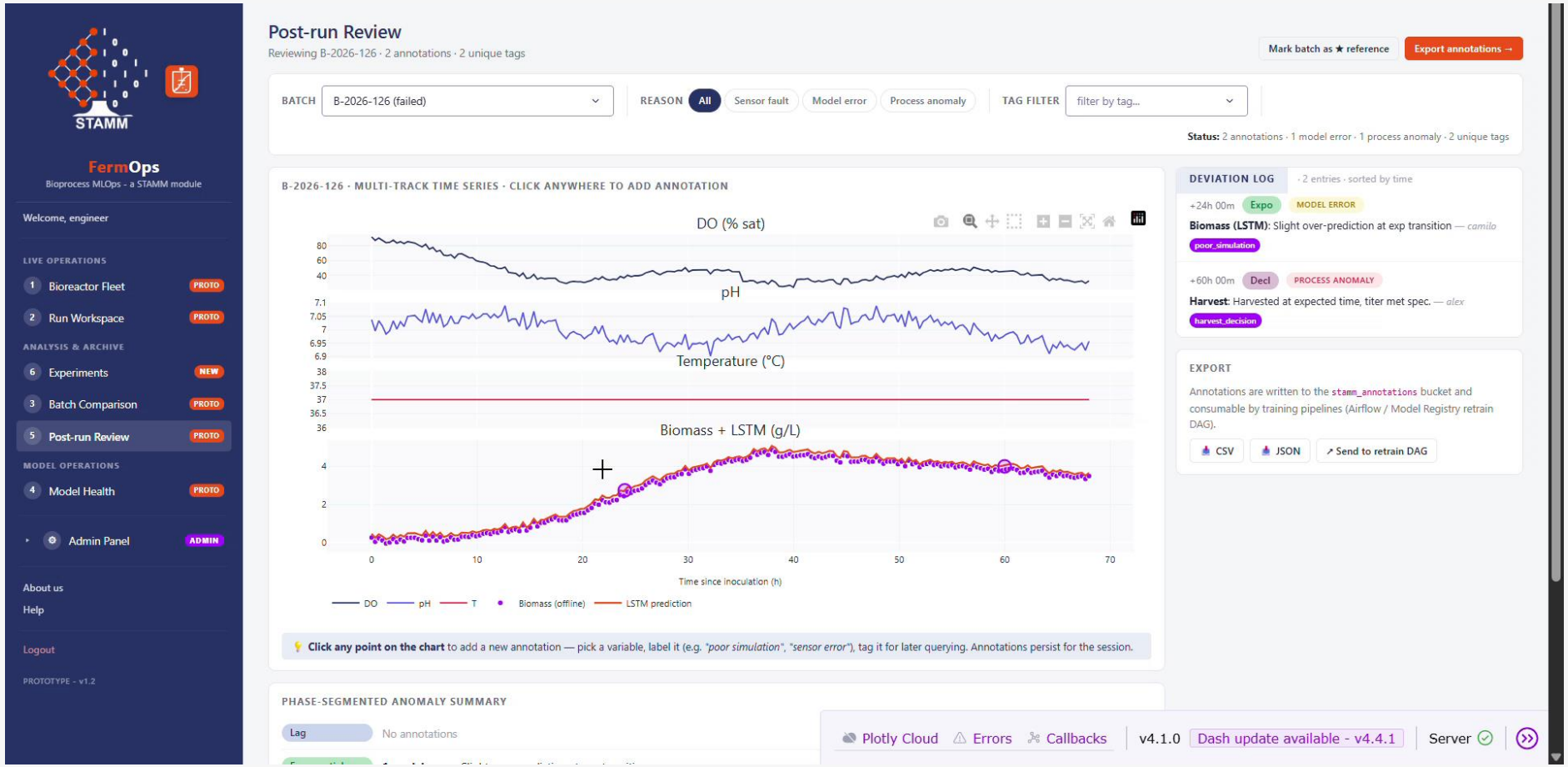

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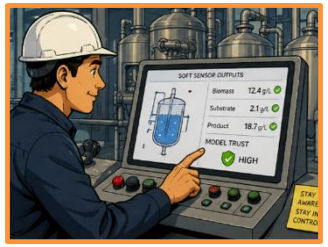

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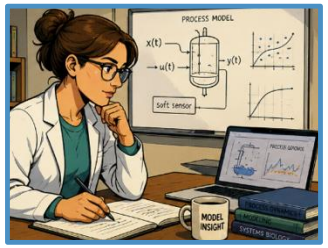

MODELLERS

ML ENGINEERS

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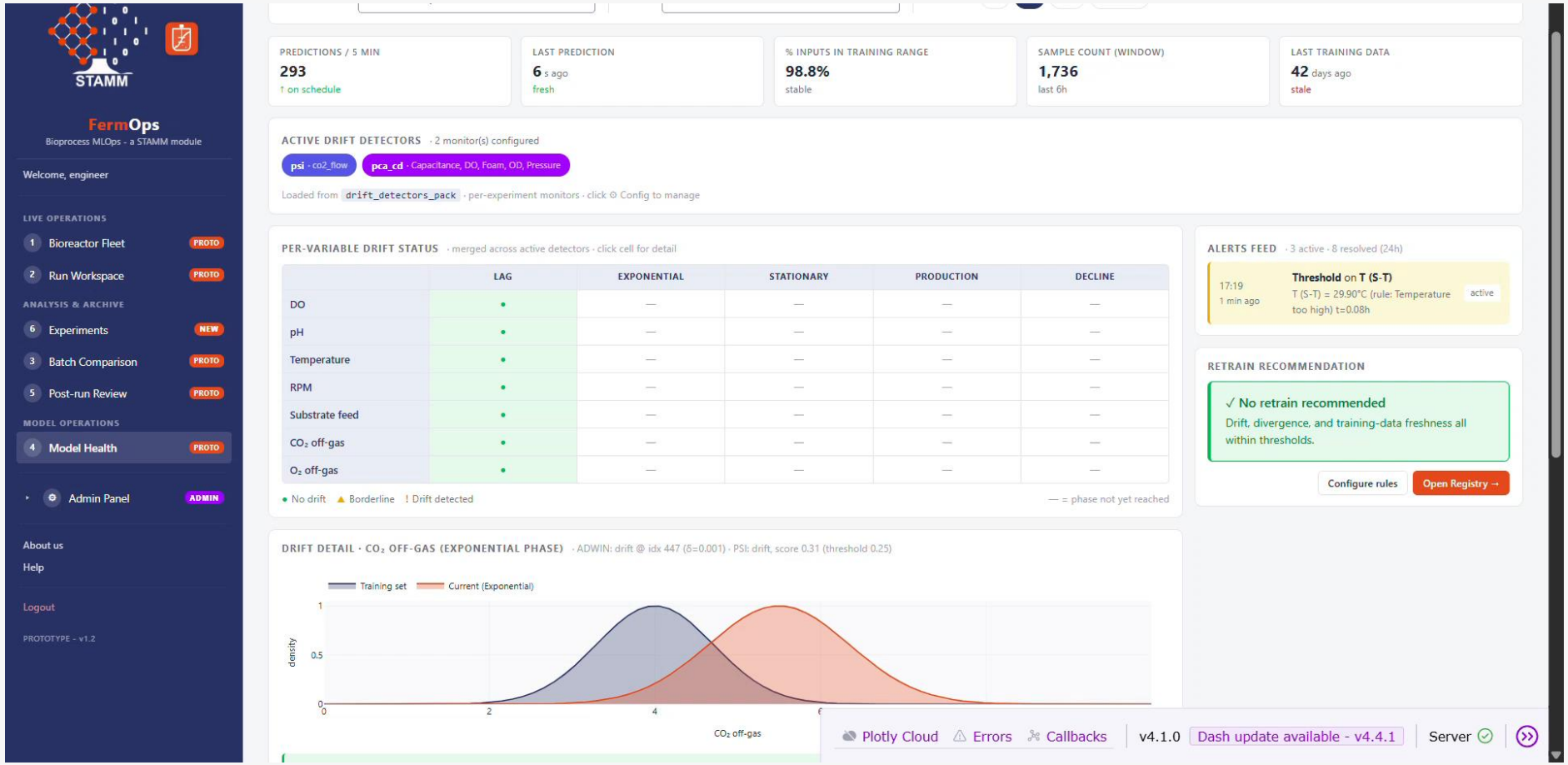

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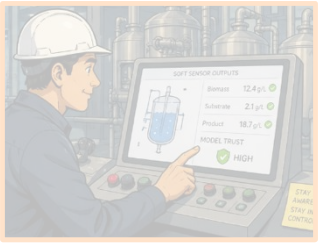

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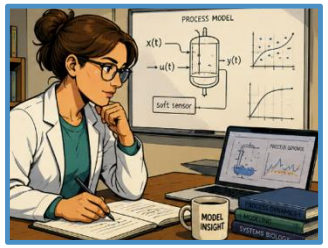


MODELLERS

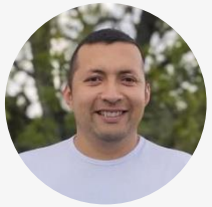
ML ENGINEERS

Thanks for listening!

THE TEAM

A multi-disciplinary team across machine learning, process engineering and biologists

David Camilo Corrales



Carlos Suárez

Santiago Aristizábal

Jasper Koehorst

Brett Metcalfe

Ariane Bize

ALUMNI

Past contributors who shaped STAMM and have since moved on.

Esteban Castillo

Matthew Crowther

PEOPLE JOINING THE TEAM SOON

Alexander Astudillo

Mariano Nicolas Cruz

BY THE END OF 2026

LET'S TALK

Three ways to take the next step.

BOOK A 20-MIN MEETING

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