



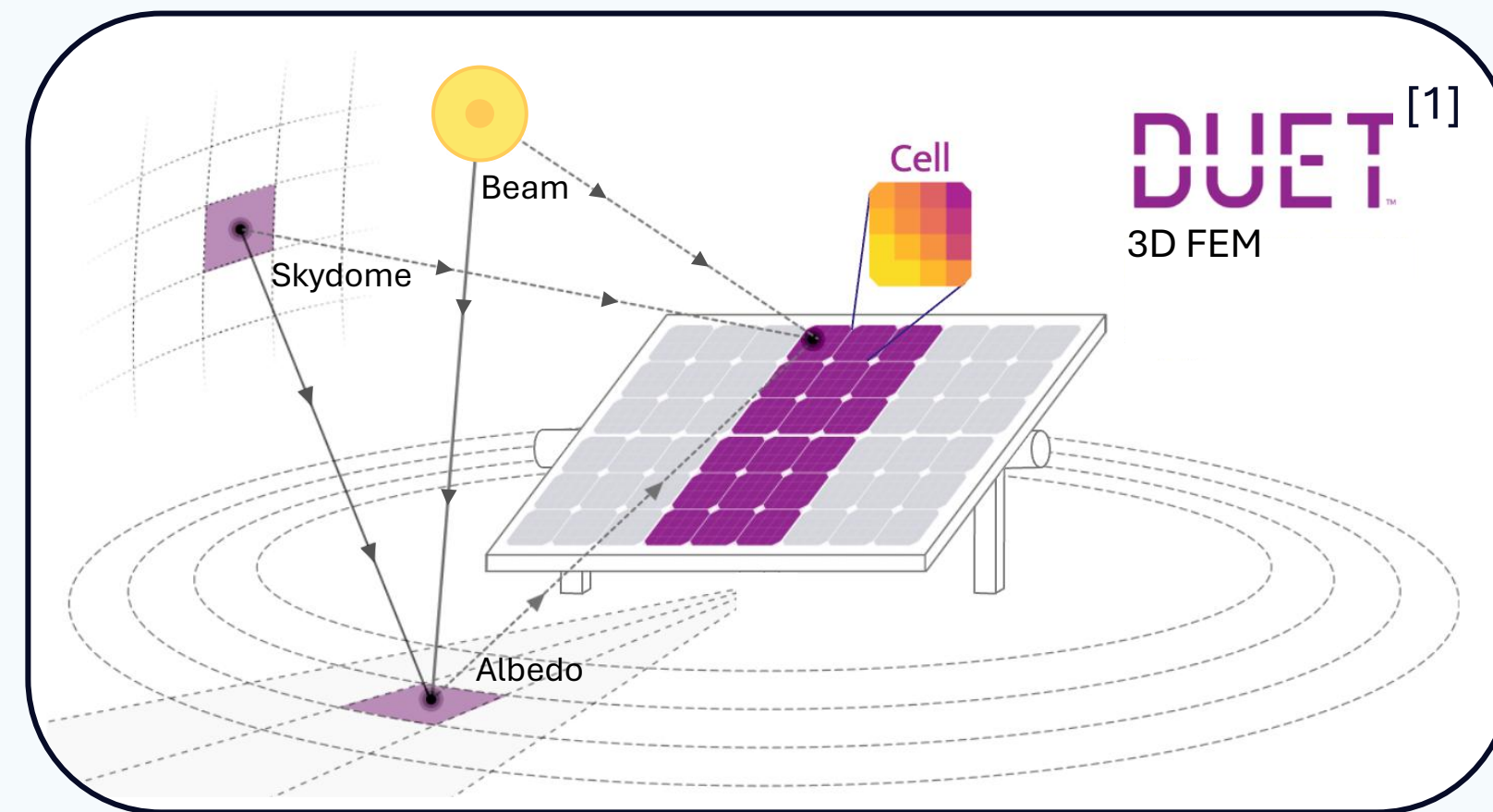
Spotting the suspects: AI-identified performance issues from a physics-modeling foundation

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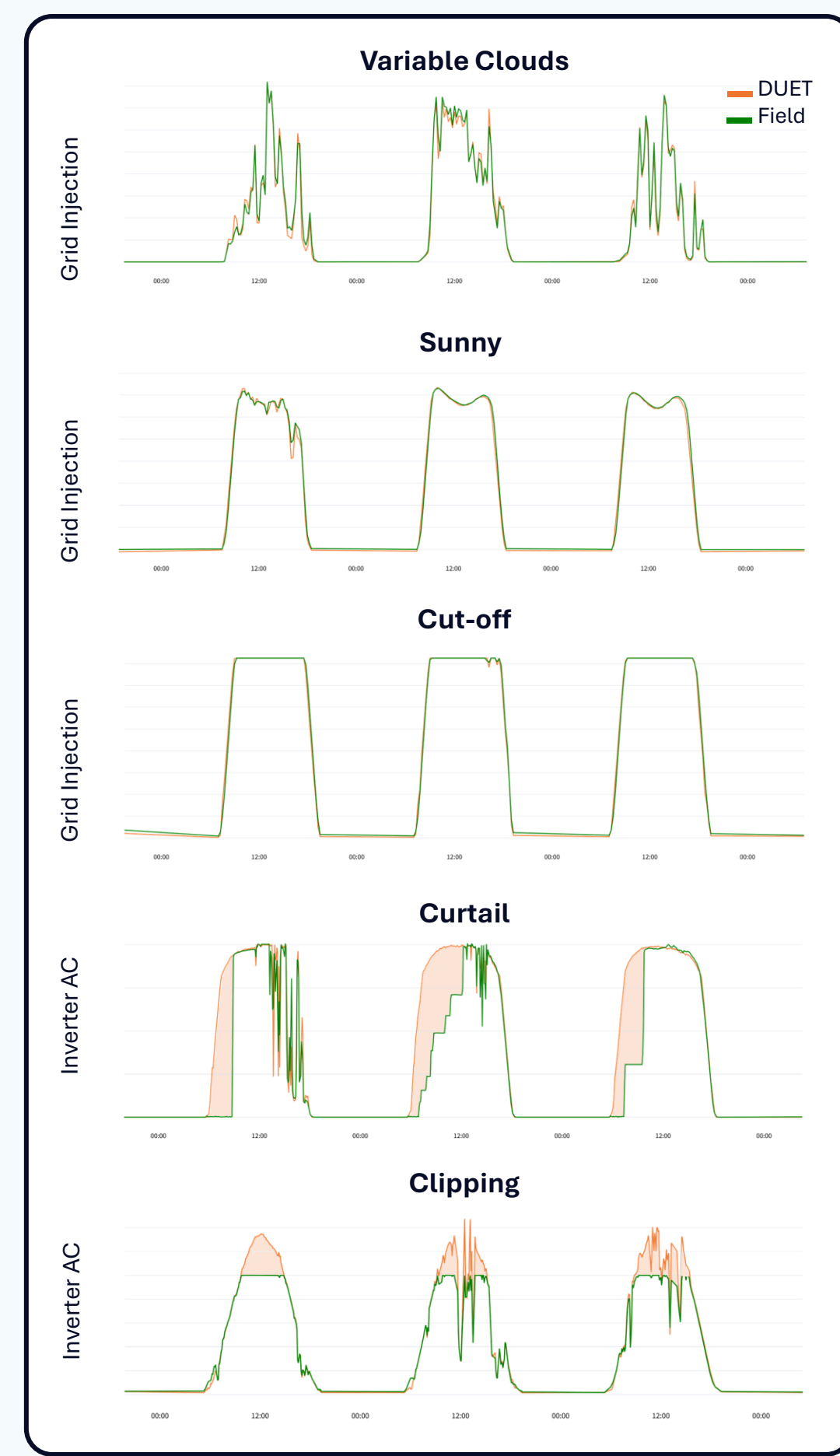
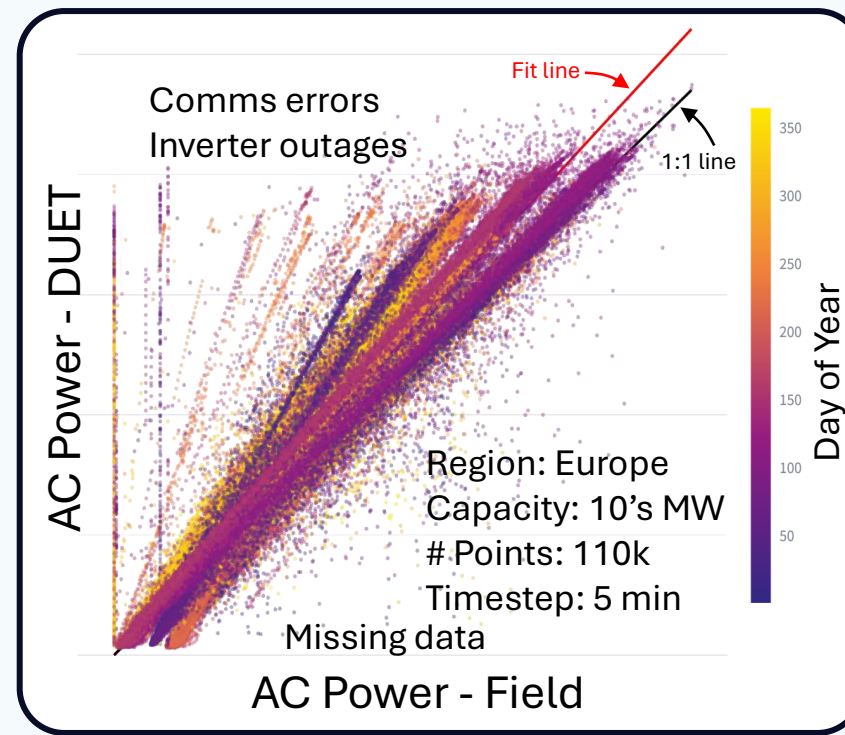
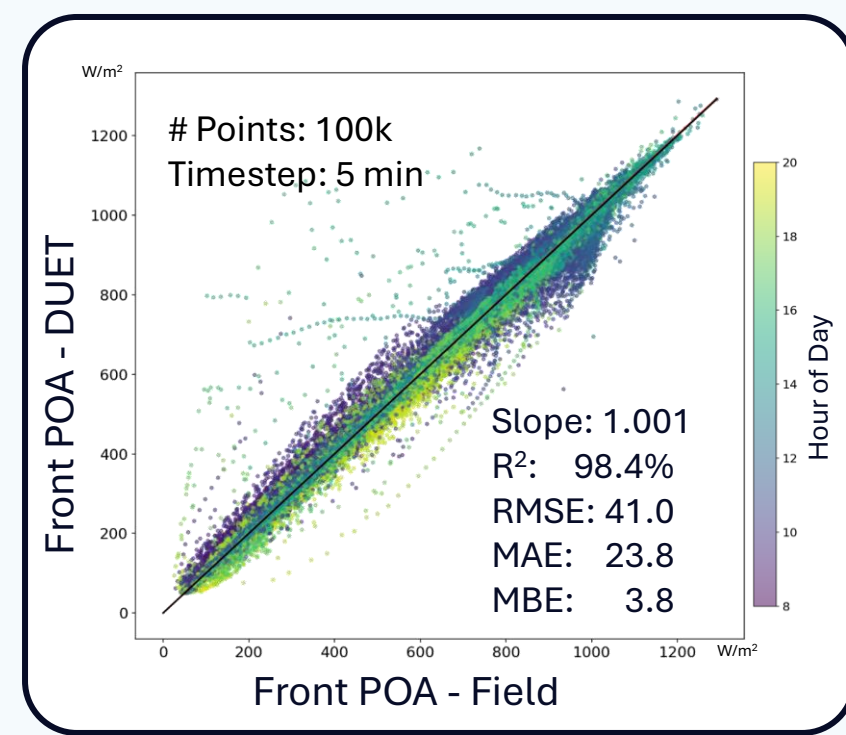
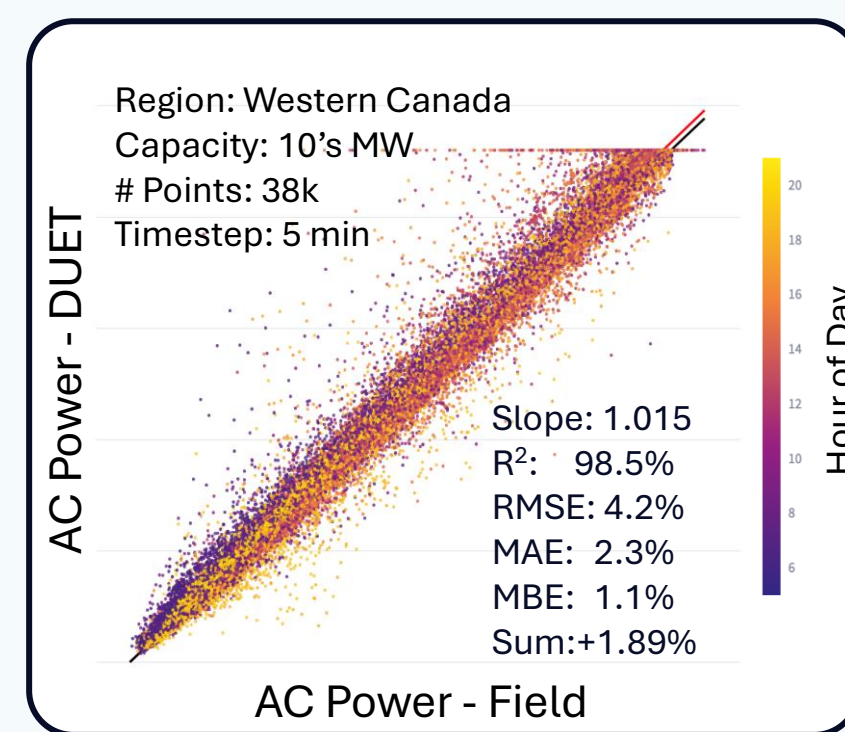
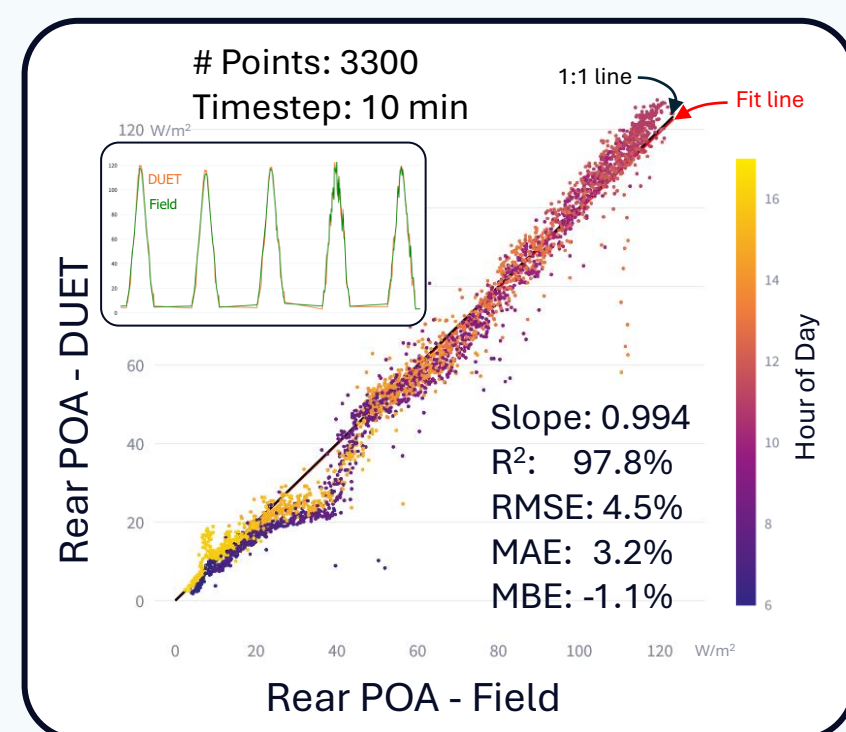
Physics-Based Model: DUET

- Novel 3D FEM approach
- Cell-to-system bifacial model
- Reduces uncertainty: eliminates empirical factors
- Reproducibility: physical inputs
- Deterministic physics-based model



Model vs Field

- 2D irradiance profiles for each timestamp
- Shading includes racking
- Rear POA fit is sensitive to 3D sensor position



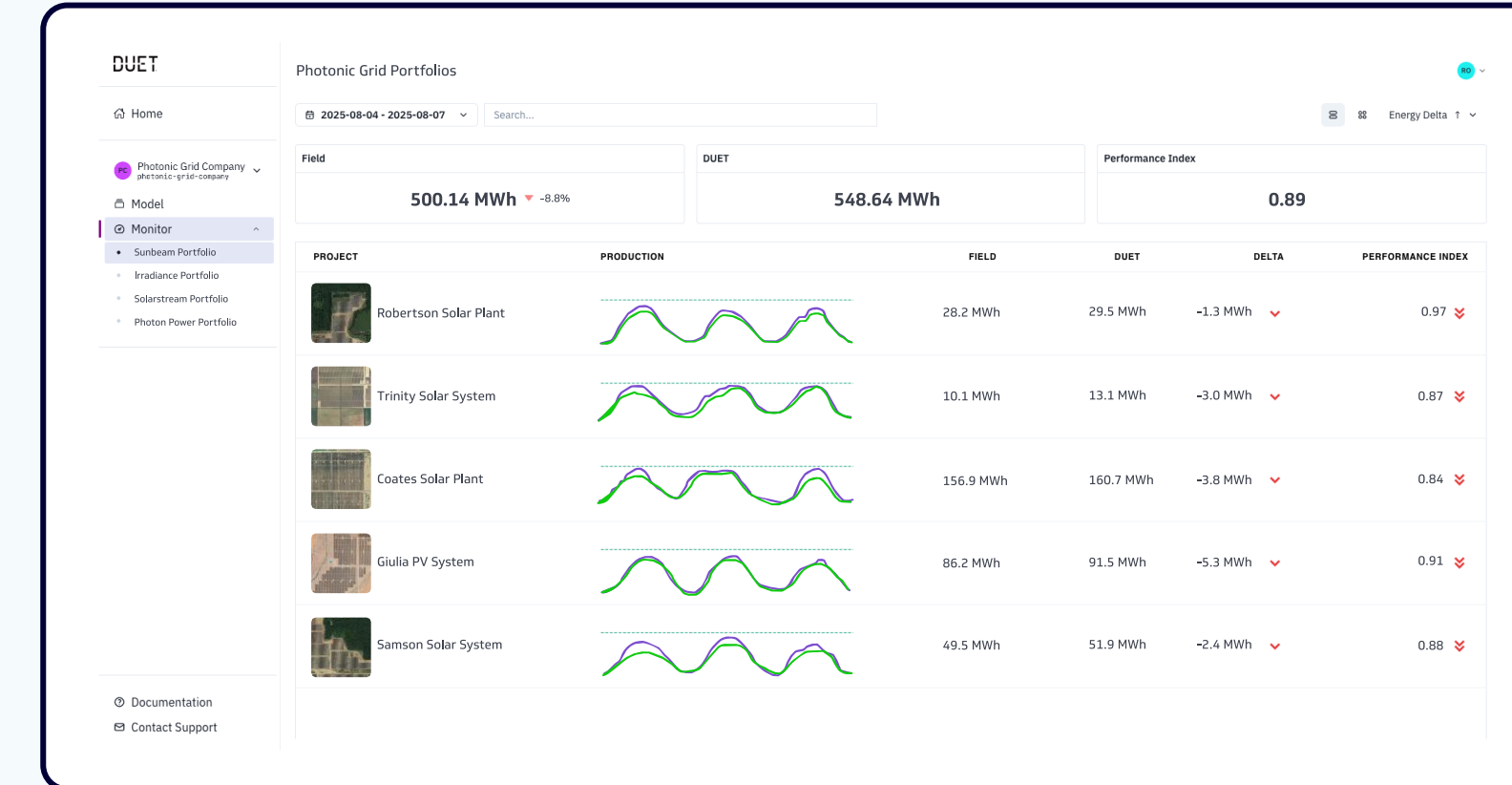
Model Continuity

- Apply model across entire plant lifecycle
 - Design
 - Capacity Testing
 - Operations
- Real-time performance baseline across all levels of a plant
- Updates during plant expansion, retrofit, or repower

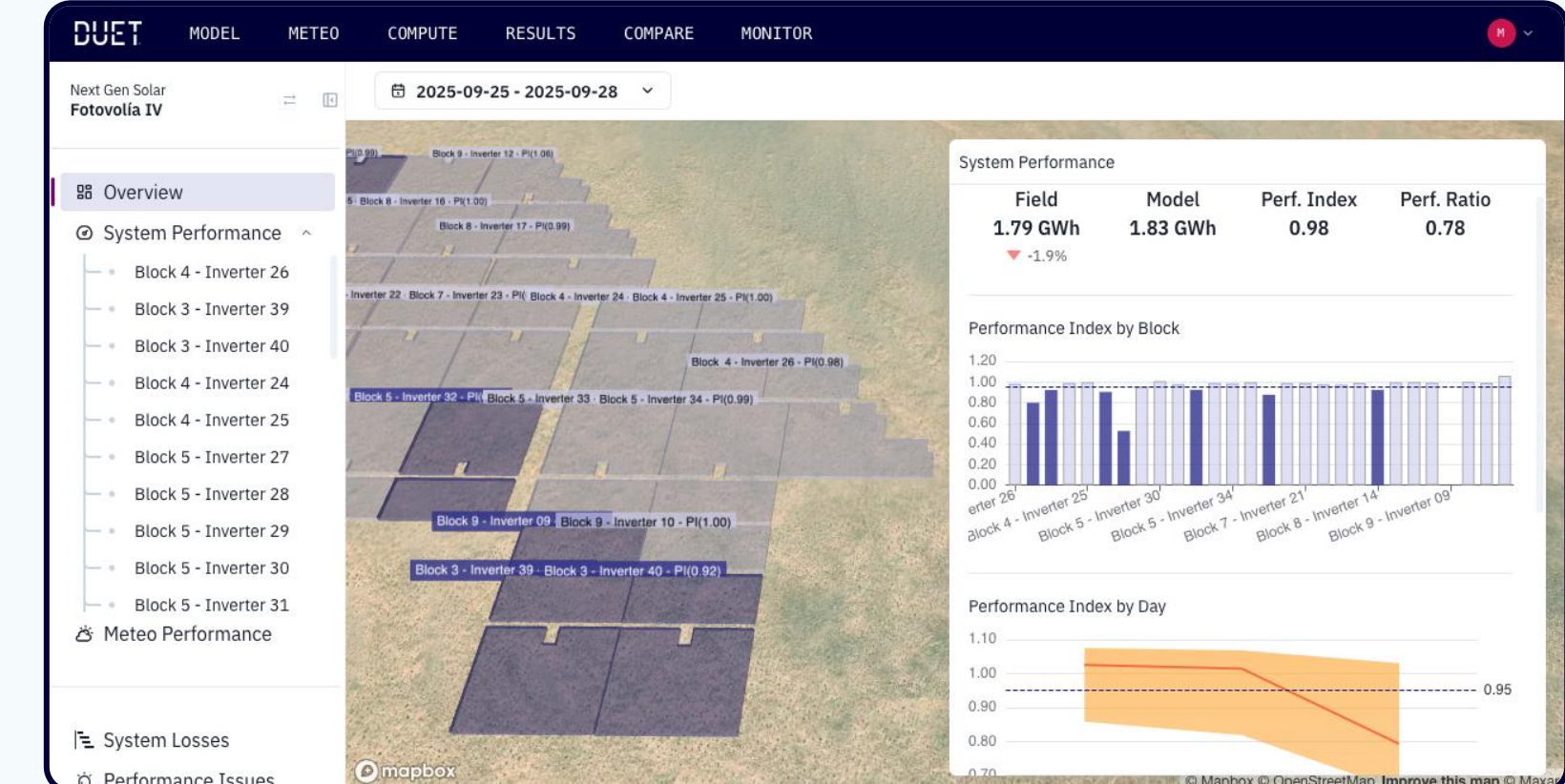
Operations & Maintenance

- Real-time performance monitoring
- DUET with field or satellite inputs
- Losses and events: identify, quantify
- Drill down for root cause analysis
- Ensure field measures are accurate, calibrated, and reliable

Portfolio



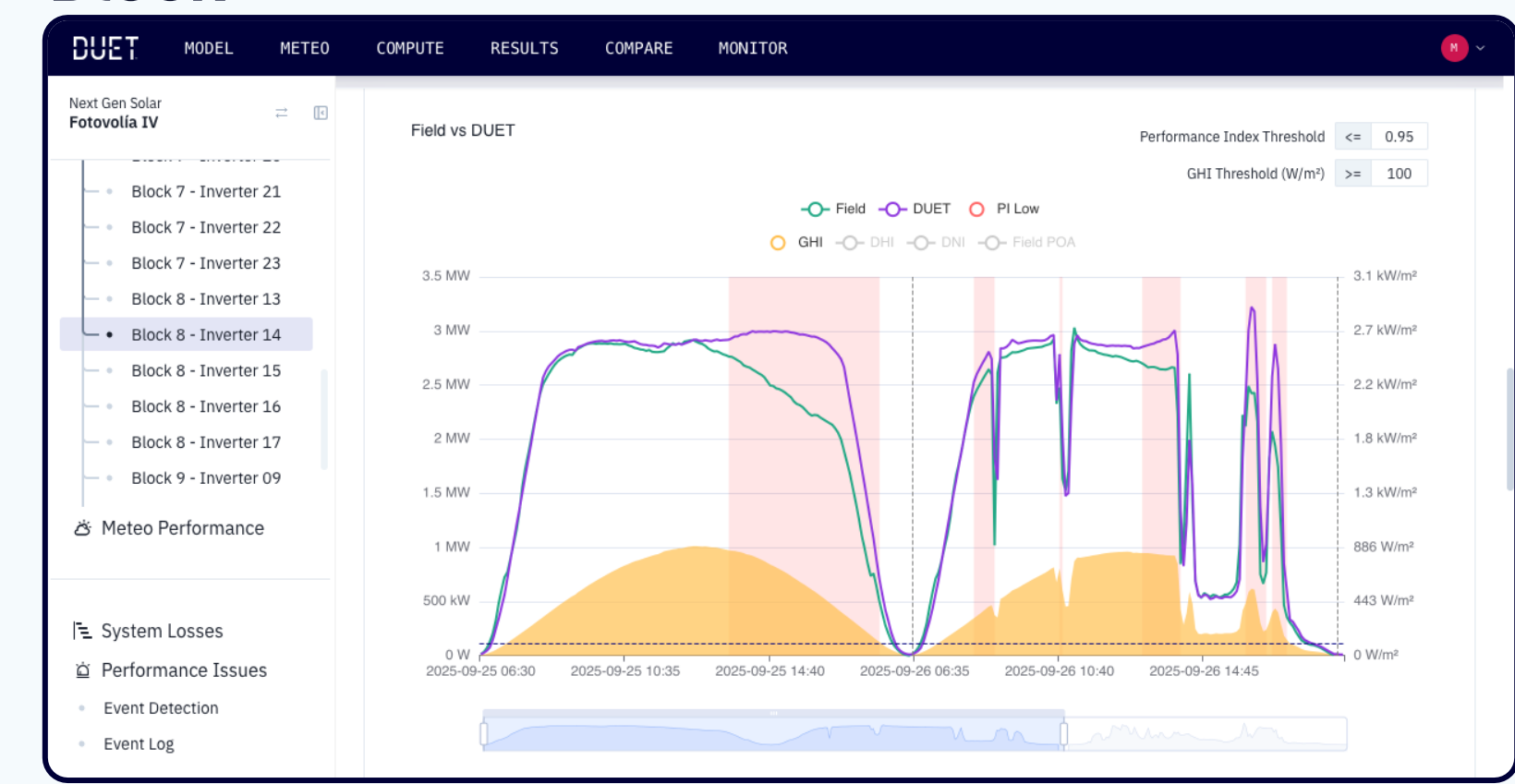
System



DC Health



Block



AI-Interpreted Performance Issues, Insights and Reporting

- Built on a bedrock of physics
- Interprets comparison of field-to-model deviations:
 - meter, inverter, combiner
- Streamline asset management
- Suspect spans: reclassify issues with a human in the loop
- Generates actionable insights

Issues | Loss Explorer | Reports | 2026-01-17 - 2026-01-17

MODEL: 915.80 MWh | MEASURED: 868.12 MWh | METER LOSS: 47.68 MWh | PI: 0.9479 | ATTRIBUTED: 19.14 MWh | UNATTRIBUTED: 28.54 MWh | RECONCILED: 0/12 spans

COMPONENT	ATTRIBUTED LOSS	SPANS	PI
Block 10C-139	1.21 MWh	3	0.79
Inverter Block 10C...	1.21 MWh	3	0.79
Block 10A-150	960.00 kWh	3	0.83
Inverter Block 1...	960.00 kWh	3	0.83
Block 12C-109	7.44 MWh	1	0.69
Inverter Block 12C...	7.44 MWh	1	0.69
Block 10C-137	8.84 MWh	2	0.63
Inverter Block 10C...	8.84 MWh	2	0.63

Meter: Meter - Site meter - PI 0.9479 | 47.68 MWh

Inverter: Inverter Trip | Pending | 2026-01-17 07:30 → 2026-01-17 11:00 | Potential: 7.32 MWh | Loss: 7.44 MWh | Weight: 14%

- Assign personnel to specific spans
- Human review of AI-detected issues

Suspect Spans

Tracker Stuck
Block 10C137-Tracker-Controll...
Block 10C137-Tracker-Controll...
URGENT 8.84 MWh

Suggested Action: Dispatch field crew to Block 10C-137 to inspect...

Justification: Motor summary for Block 10C-137 confirms all...

Verify All | Verify | Relabel | Give feedback | Confidence 0.96

Inverter Trip
Block 12C109-Inverter-1-activ...
HIGH 7.44 MWh

Suggested Action: Pull inverter fault log for Block 12C109-Inverte...

Justification: 30-min PI timeseries for Block 12C109:...

Verify All | Relabel | Give feedback | Confidence 0.88

String Open Circuit

- Drill down to verifiable root cause
- Initial estimate of recoverable losses

Stuck Tracker

Inverter Power

Tracker Angle

Estimated Loss

LOSS CATEGORY	COMPONENTS	LOSS (MWh)	% OF TOTAL	PRIORITY
Tracker Stuck	Block 10C137-Tracker-Controller-1 Block 10C137-Tracker-Controller-2	8.84 MWh	46.2%	URGENT
Inverter Trip	Block 12C109-Inverter-1-active-p...	7.44 MWh	38.9%	HIGH
String Open Circuit	Block 10C139-Inverter-1-Comb... Block 10C139-Inverter-1-Comb... Block 10A150-Inverter-1-Comb... Block 10A150-Inverter-1-Comb...	2.38 MWh	12.4%	HIGH
String Underperformance	Block 10C138-Inverter-1-Combine... Block 10C138-Inverter-1-Combine...	0.48 MWh	2.5%	MEDIUM
TOTAL		47.68 MWh	100%	

[1] A. C. J. Russell, C. E. Valdivia, C. Bohémier, J. E. Haysom, K. Hinzer, DUET: A novel energy yield model with 3-D shading for bifacial photovoltaic systems, IEEE J. Photovoltaics, 12(6), 1576-1585 (2022). DOI: 10.1109/JPHOTOV.2022.3185546.

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