Exploiting Spatiotemporal Correlations in Environmental Monitoring Networks

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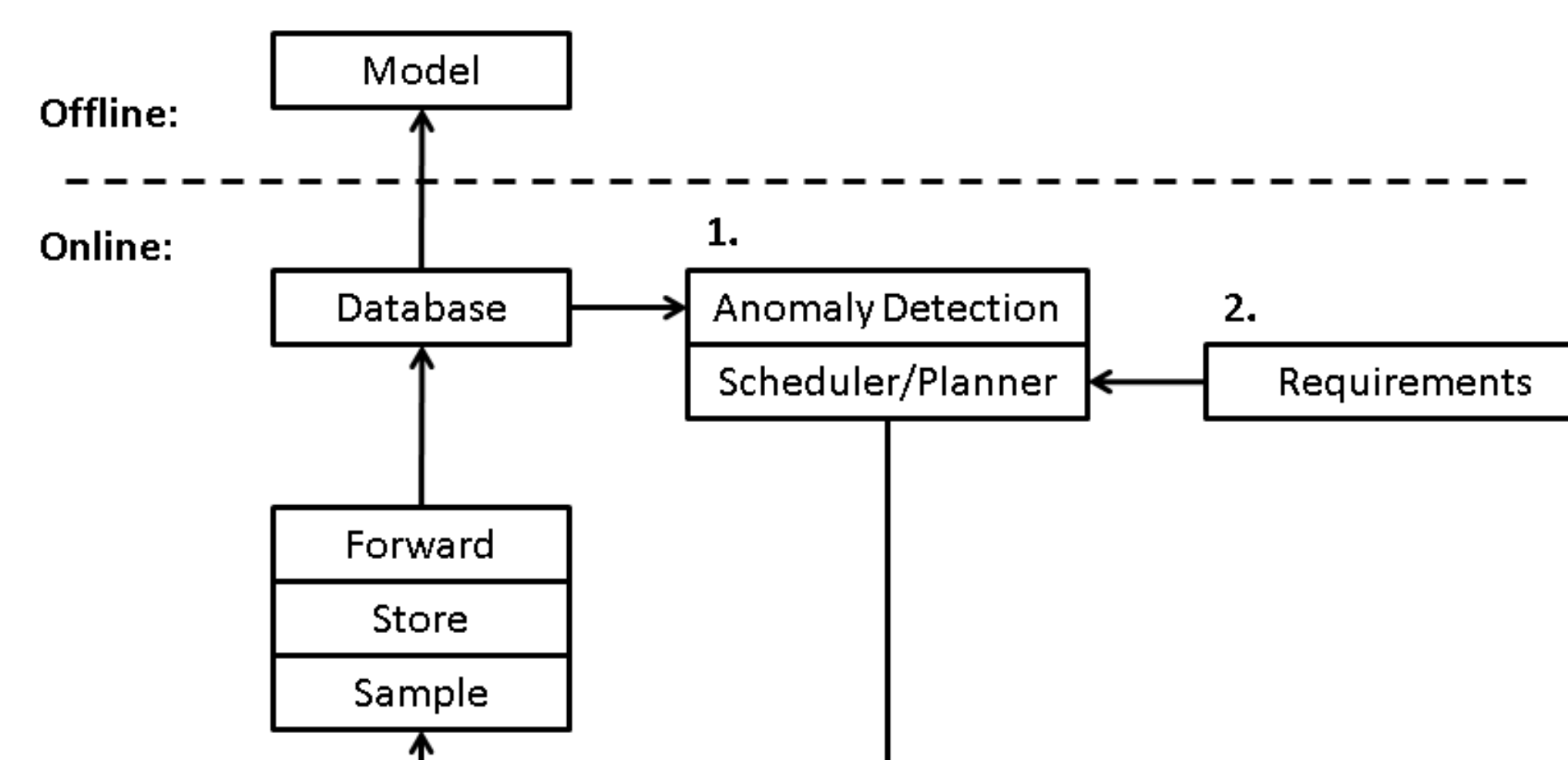
Stakeholders

Data from real deployments

- Data from real deployments tends to contain faulty readings and missing values

- Scientists require fault-free and gap-corrected data to work with

- Spatiotemporal correlations in data allow us to identify anomalies and interpolate missing values

- Principal component analysis based methods are employed to "repair" the data [1]

Cub Hill deployment near Baltimore

0   15   30   60 Meters

Autonomous data acquisition [2]

Offline: Model

Online: Database → 1. Anomaly Detection → 2.
Scheduler/Planner ← Requirements

Forward
Store
Sample

- Artificial Intelligence (AI) planner transforms ecologists requirements into a constraint optimization problem

- Online anomaly detection system suggests sampling locations

- AI solver finds optimal sampling strategy

Soil temperature dataset

○ Fault Examples   ○ Missing Values Example
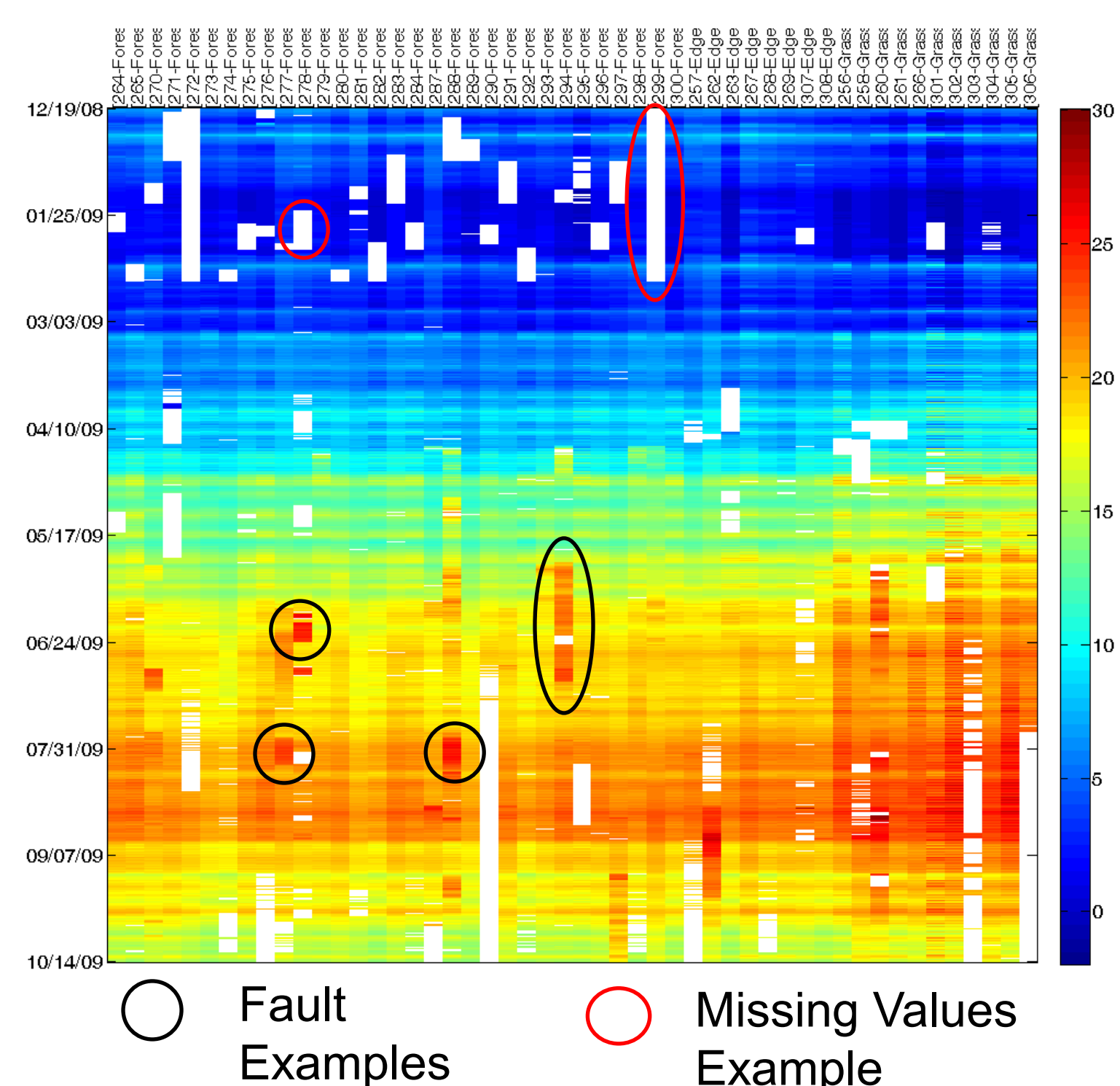
Fault-free and gap-filled dataset
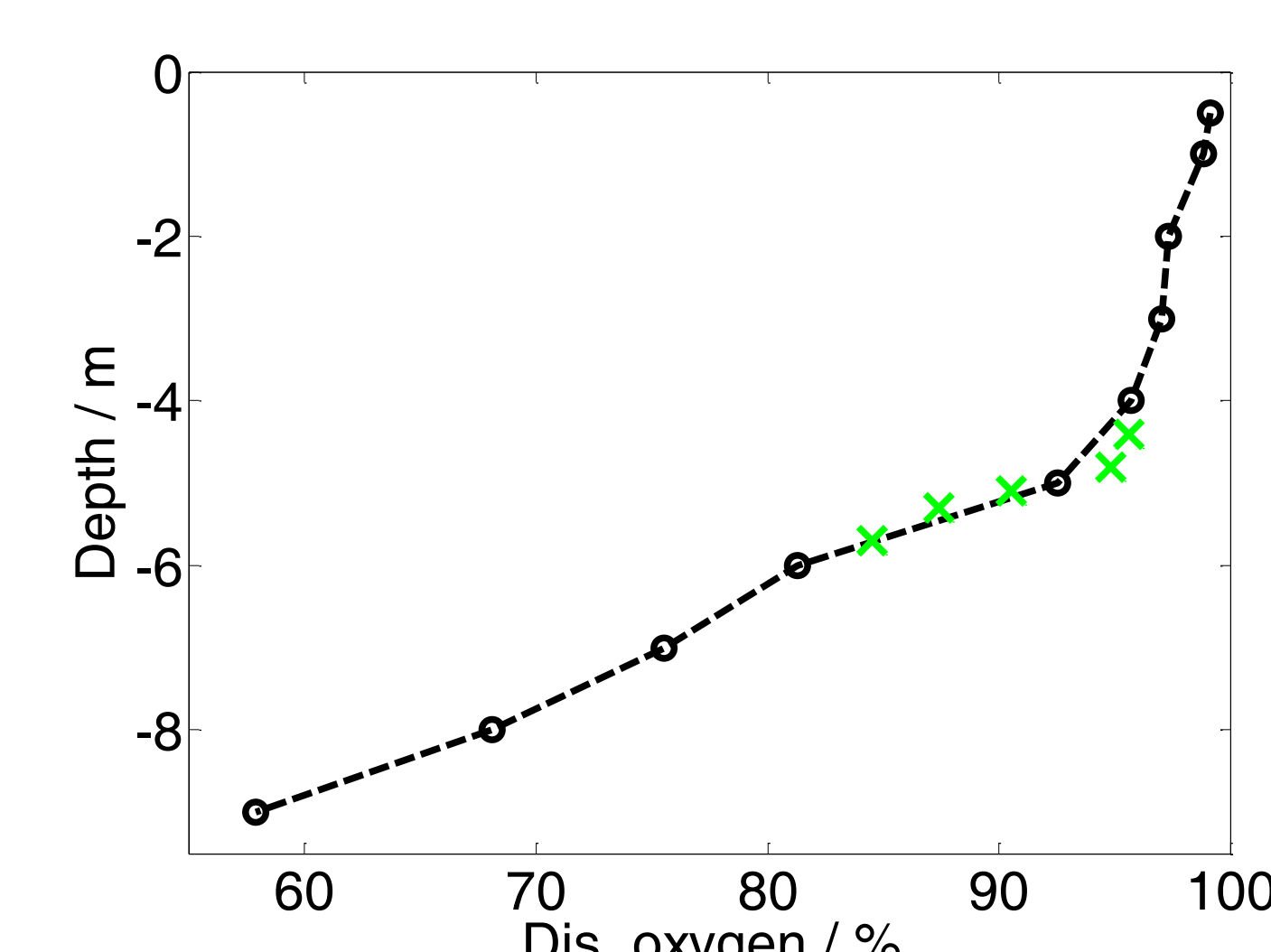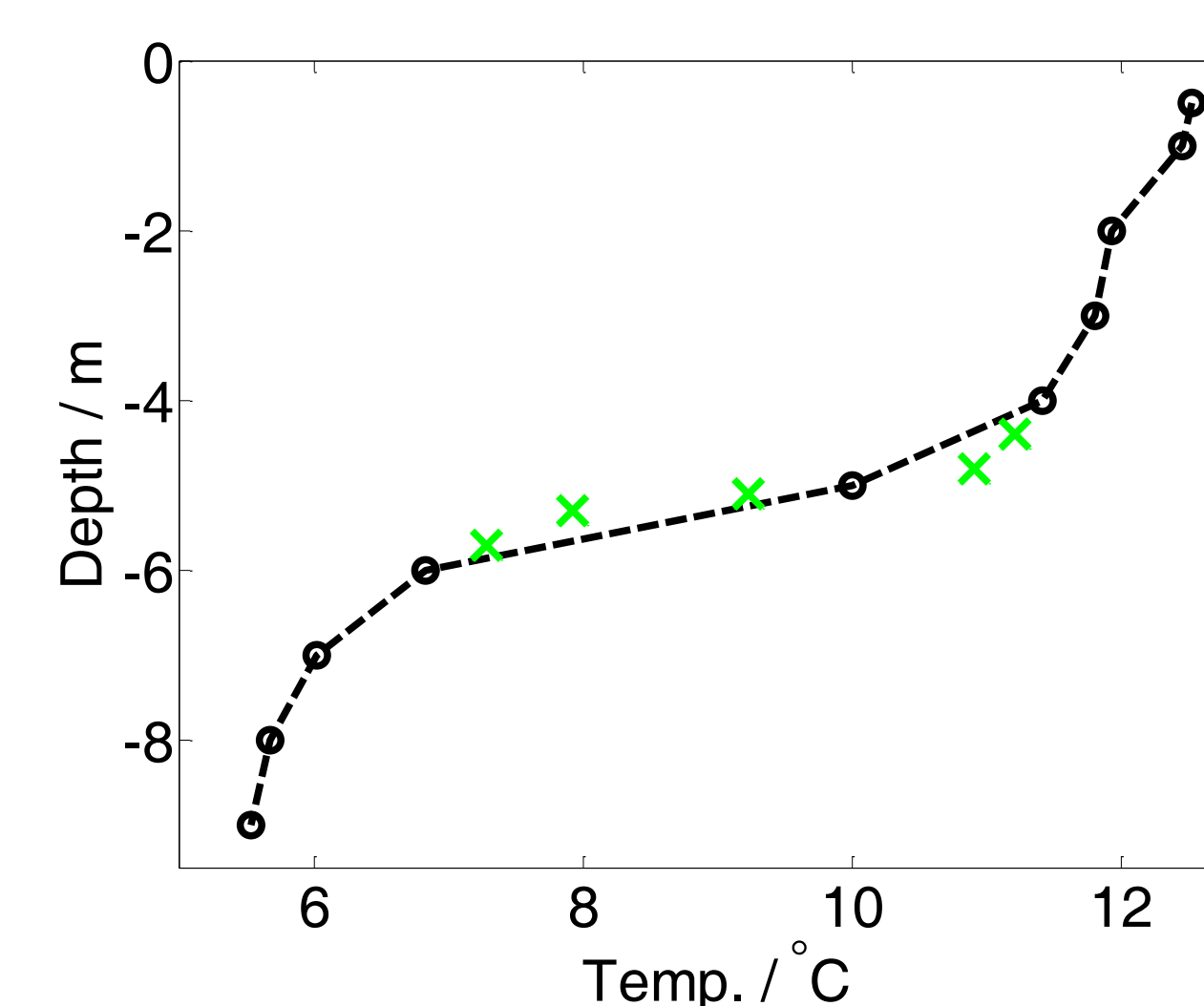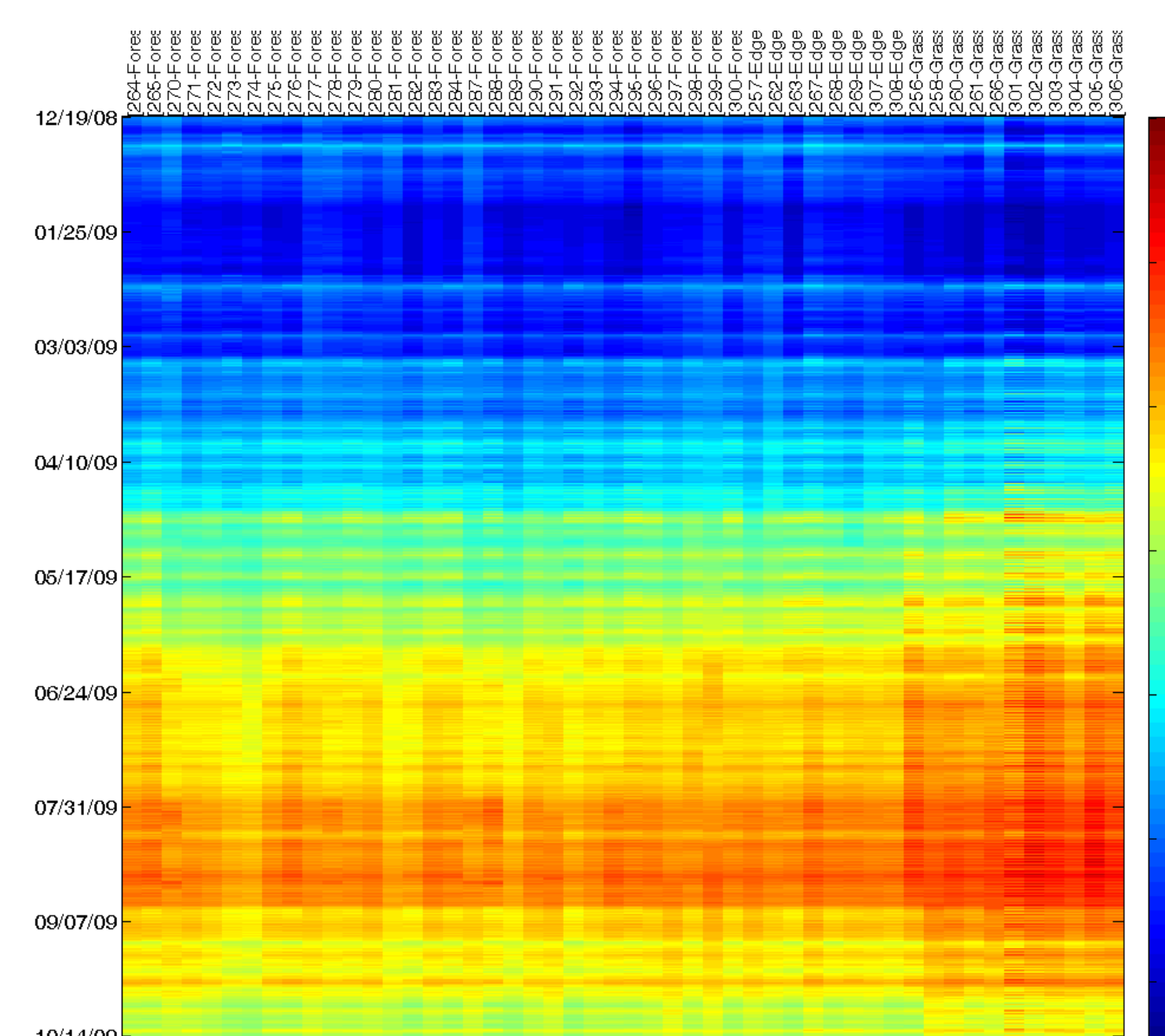
Adaptive sampling successfully tracks moving stratification layer and yields accurate oxygen distribution

References:
[1] : A Robust Classification of Galaxy Spectra: Dealing with Noisy and Incomplete Data,Connolly, A. J. and Szalay, A. S., *The Astronomical Journal, vol. 117, pp.*2052–2062, May 1999.
[2] : Meeting ecologists' requirements with adaptive data acquisition, M. Chang, P. Bonnet, In Sensys 2010

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