Nextent Labs

9th INDIA INTERNATIONAL WATER WEEK-2026

BHARAT MANDAPAM · 22–26 SEPTEMBER 2026

THEME · CLIMATE RESILIENT WATER MANAGEMENT

TF 18 · AQUIFER MAPPING AND MANAGEMENT · 25 SEPTEMBER 2026

How does a groundwater reading earn your trust ?

Automated telemetry QA, anomaly detection, noise suppression and predictive forecasting for real-time groundwater monitoring networks

Samuel Dayanidhi Pachaiyappan

Founder & CEO, Nextent Labs Private Limited

Field demonstration conducted with CGWB Kerala Region

Ref: NXT/CGWB/KR/HGS/2026/01

10	37	6-hourly
CGWB stations, Kerala	months · 3.1 years	4,000 readings / station

Resilience is a claim about the future

It rests entirely on the data beneath it.



↓

Head data feeds storativity → storage change → block classification

So data integrity is a scientific question before it is an administrative one.

CGWB has built one of the world's largest groundwater observation networks.

The scientific opportunity

Make every reading from it carry its own evidence — auditable, flagged, and traceable to a decision.

There is no climate-resilient water management without a defensible record of what any weather is actually doing.

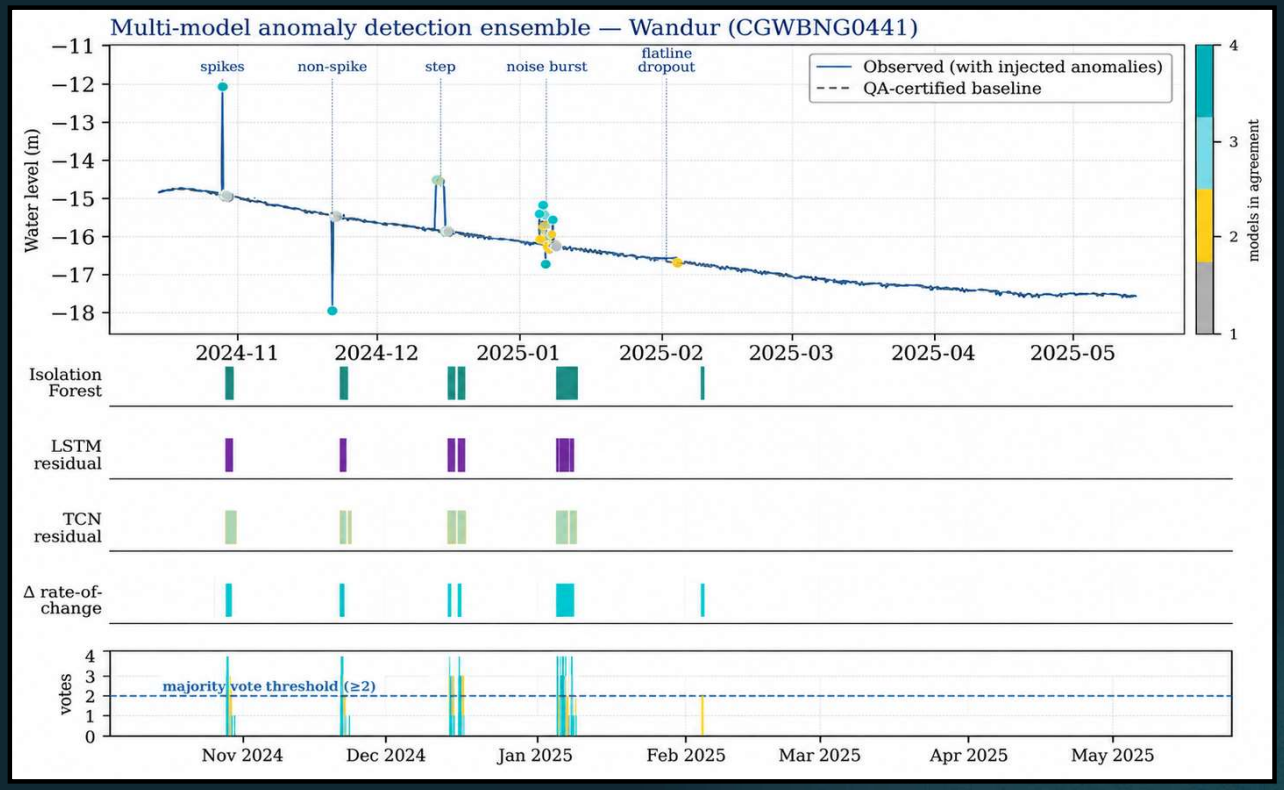
Four stages from raw sensor to governed record

THE FRAMEWORK



Every correction is logged with its original value, the method applied, and the reviewer's identity — raw data is never deleted or altered.

No single detector catches every failure mode



Ensemble, not oracle

Isolation Forest
point outliers

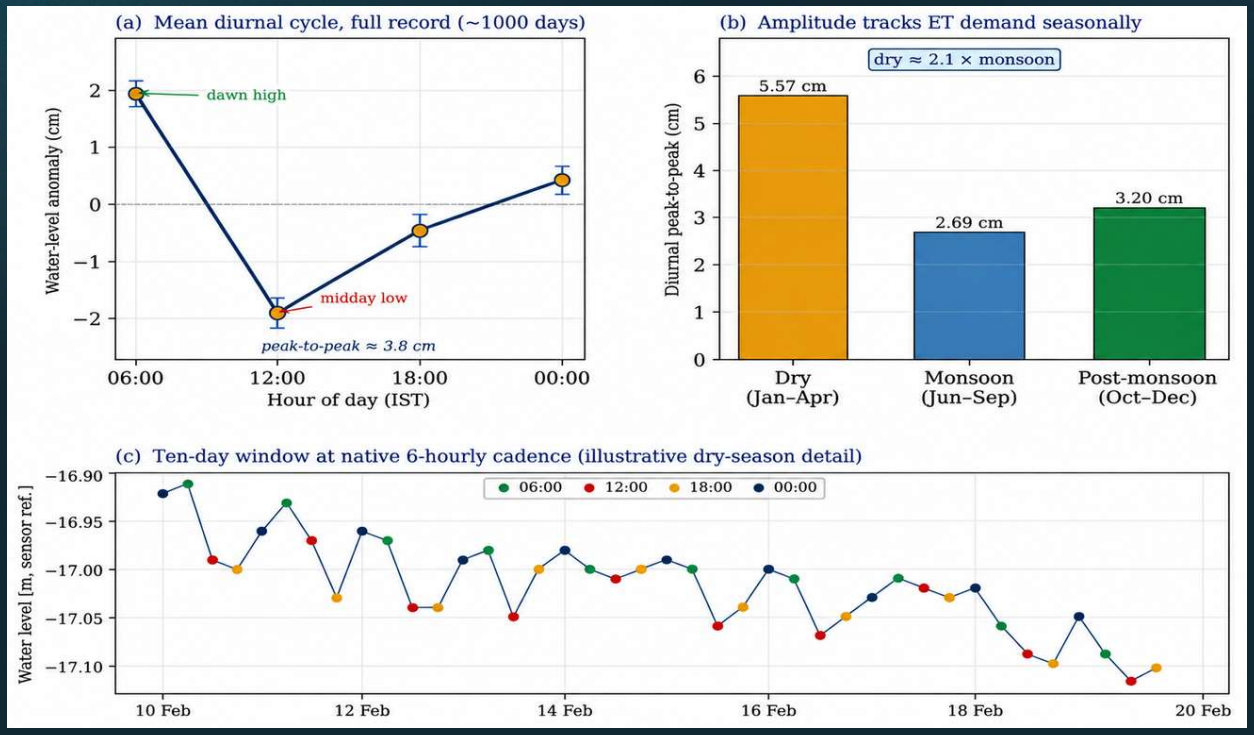
LSTM residual
sequence breaks

TCN residual
non-linear drift

Δ rate-of-change
hard physical limits

Majority vote (≥ 2 models) recovered all five injected failure types — while suppressing single-model false alarms.

The signal you must protect — and the one you cannot claim



DEFENSIBLE

~24 h diurnal signal

3.8 cm peak-to-peak, recovered by stacking ~1,000 days. Dry-season amplitude is 2.1× the monsoon — the evapotranspiration signature (White, 1932).

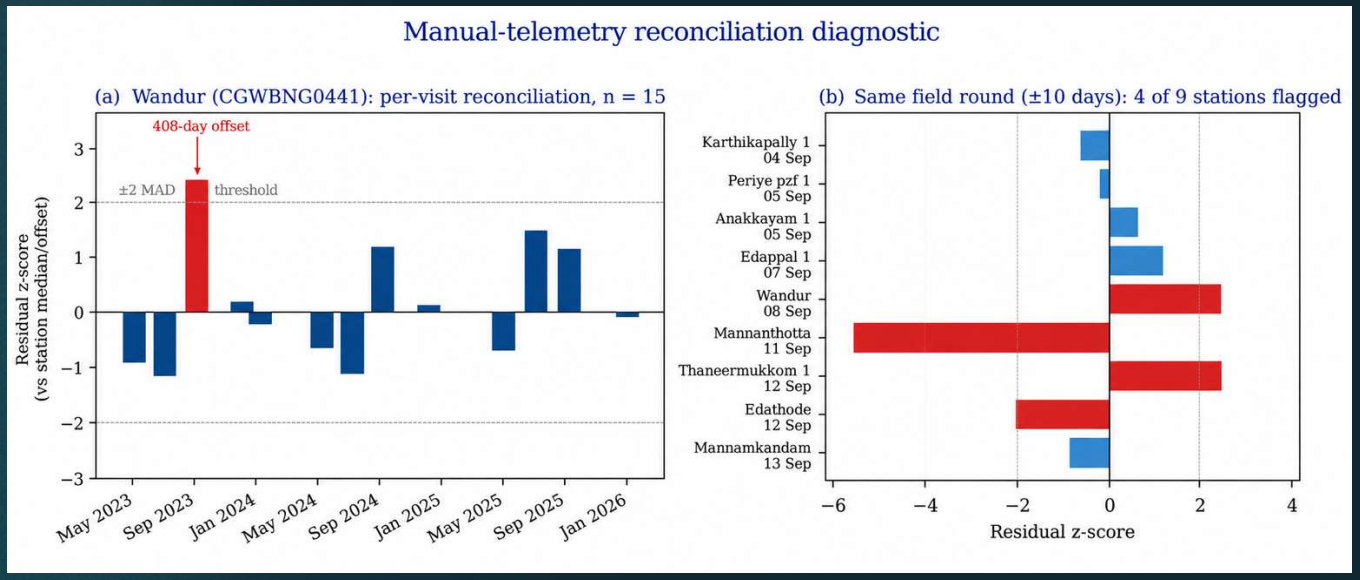
REMOVED FROM THE PAPER

M2 Earth tide (12.4 h)

At 6-hourly sampling the Nyquist limit is 12 h. The claim was indefensible, so we withdrew it.

Cross-checking makes both streams stronger

FINDING · TWO PLANES OF DATA



Telemetry and manual observation are independent measurements of the same aquifer. Comparing them systematically — rather than assuming either is ground truth — lets the network flag where a reading deserves a second look, and confirms the far larger share that agree.

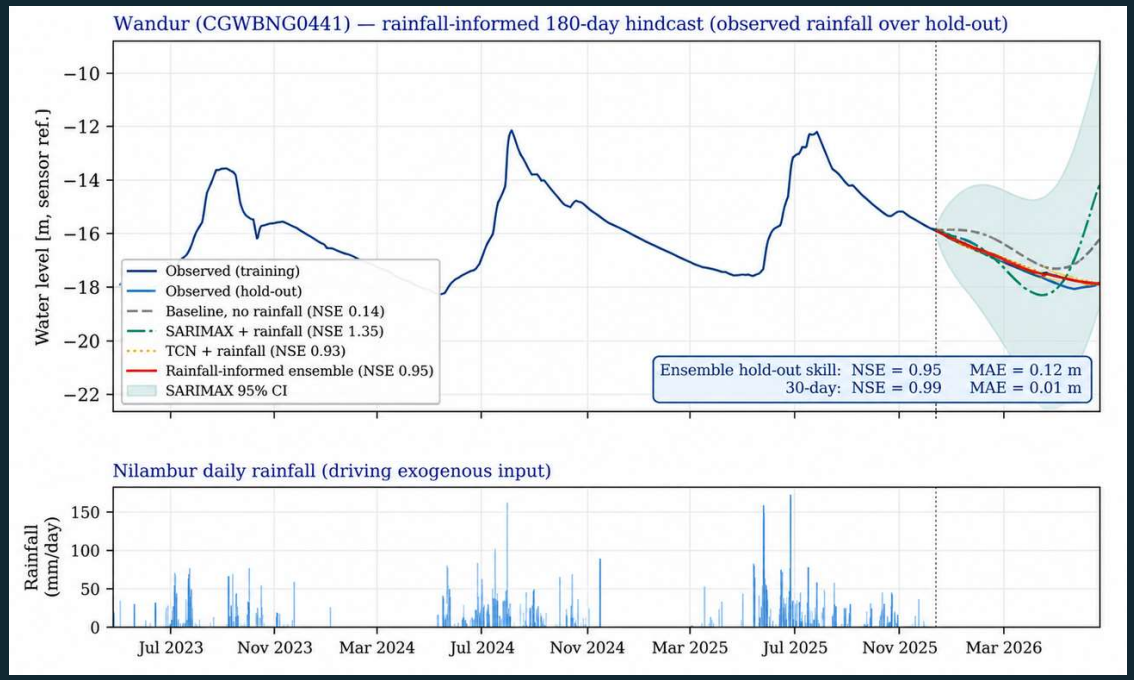
14 of 15

manual observations at Wandur agreed closely with telemetry across 3.1 years

Where a difference did appear, it grouped by survey round rather than station — a pattern no single well could reveal.

That is a signal about measurement conditions, not about any officer's work.

The climate signal is what makes the forecast work



Baseline — no rainfall

NSE −0.14

Small absolute error, but no skill: the model could not anticipate when the recession would level off.

SARIMAX + TCN, rainfall-driven

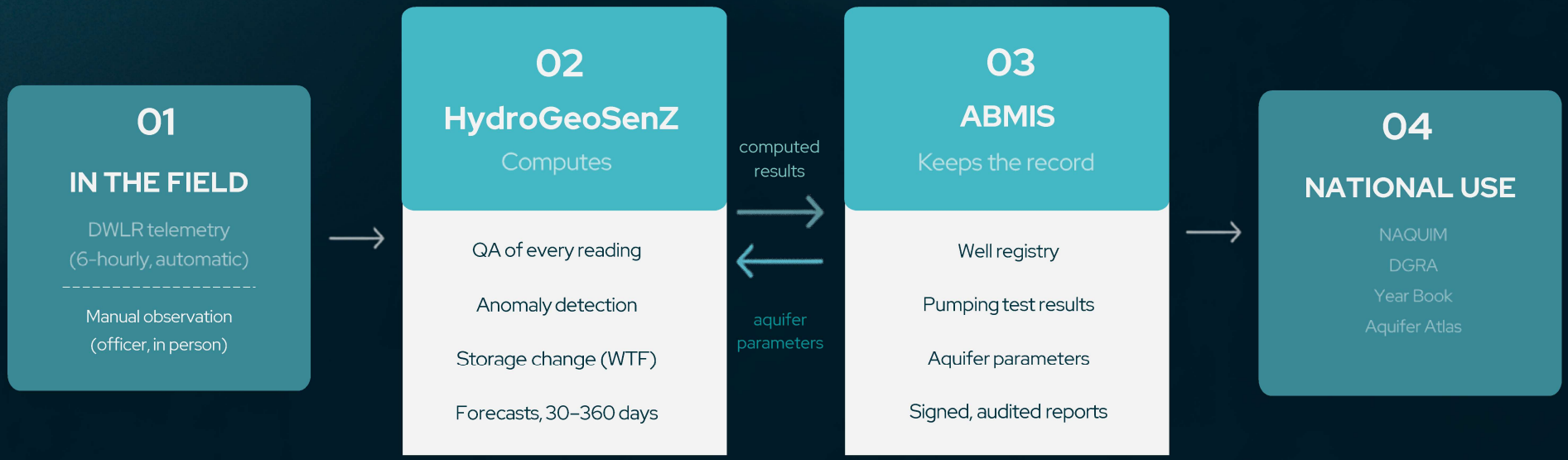
NSE 0.95

180-day hold-out, MAE 0.12 m. Horizon-adaptive blend driven by an antecedent precipitation index.

A model blind to rainfall can only extrapolate the past — it cannot be climate-resilient.

Where QA-certified data meets aquifer management

FROM DATA TO
AQUIFER CHARACTERISATION



The quality flag travels the whole way

Any number in a national report can be traced back to the reading it came from - and to how good that reading was.

Three foundations for climate-resilient groundwater governance

IMPLICATION · CLIMATE RESILIENT WATER MANAGEMENT

Provenance and plausibility

Two different questions: was the reading captured where and when it claims, and can the value itself be reliable? Cryptography answers the first; only statistics answer the second.

Manual observation is the backbone for the next decade

Roughly 6,000 telemetry wells sit alongside some 25,000 CGWB stations. Verified digital capture would strengthen — not replace — the observer network.

Forecasts coupled to the climate driver

Groundwater prediction must ingest rainfall to be resilient — linking climate services to aquifer management, with skill reported honestly per horizon.

State-level instruments feeding the national picture - each shown with its honest current status

GroundTruth

Verified capture at the wellhead

In development

UWDx — Unified Water Data Exchange

Consent-based sharing between departments.

Proposed to MoJS

HydroGeoSensZ² / ABMIS

Conceptual and governed record

In CGWB pilot

Every reading should be able to prove itself.

ANSWERING THE OPENING QUESTION .
CLIMATE RESILIENT WATER MANAGEMENT

- A five-model ensemble catches failure modes no single detector sees.
- Noise suppression protects the diurnal signal — and withdraws what sampling cannot support.
- Cross-checking two independent streams strengthens confidence in both.
- Rainfall-driven forecasting lifted 180-day skill from NSE −0.14 to 0.95.

Climate resilience begins with a groundwater record that can withstand scrutiny.

With thanks to Dr. D. Gnanasundar, Regional Director, and officers of CGWB Kerala Region, Thiruvananthapuram.

Thank you

Nextent Labs

Samuel Dayanidhi Pachaiyappan

Mobile No: +61423217812

Email: samuel@nextentlabs.com

www.nextentlabs.com