HGP Scientific Research Pack (v2)
Deep-Dive Dossier: Theory • Models • Metrology • Statistics • Simulations

Safety-first compilation. No hazardous build instructions. Includes reproducible datasets and figures.

Executive Summary

This document expands the initial dossier into a full research pack: clear axioms and hypothesis space, formalized falsification gates, metrology-first measurement design, and a reproducible simulation suite. All quantitative work herein is illustrative and intended to stress-test analysis pipelines and prevent false positives.

Included assets

Asset	Where
Figures + data (CSV/JSON)	/out
Markdown chapters & templates	/docs
Reproducibility scripts	/scripts
Source PDFs (author provided)	HGP_original.pdf, HGP_extended.pdf

1. Prolog and Research Stance

We adopt a strict 'architect of hypotheses' posture. The goal is not to claim feasibility, but to build an internally consistent theoretical world and to derive testable predictions. Any effect must be demonstrated via metrology-grade controls before interpretation.

This pack is therefore structured as: (a) explicit axioms; (b) hypothesis branches; (c) falsification gates; (d) measurement logic; (e) simulations estimating false-positive rates; (f) templates enabling preregistered protocols.

2. Axioms, Variables, and Hypothesis Branches

A1: Gravity is treated as emergent optimization over informational state complexity. Newton/Einstein remain effective macro-laws.

A2: The substrate tends to reduce an abstract existence-cost functional $C_{total} = C_{energy} + C_{entropy} + C_{compute} + C_{instability}$ (schematic).

A3: Soft spots: high degrees-of-freedom domains are most responsive (vacuum-like fluctuations, asymmetry fields, boundary conditions).

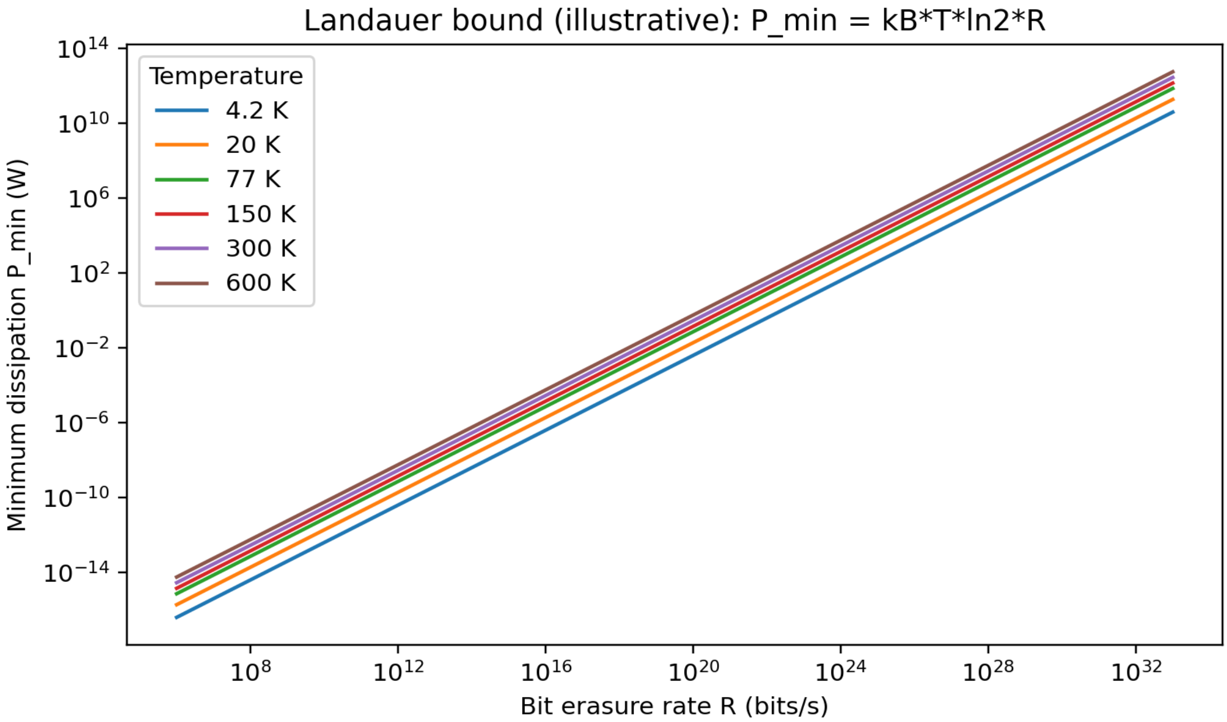
We define a branch ladder (H0–H4) and require progress only by passing staged falsification gates.

3. Mathematical Framing and Sanity Constraints

This section uses information-theoretic and thermodynamic language as modeling tools. A key sanity constraint is Landauer's bound: irreversible erasure at temperature T requires at least kB*T*ln2 per bit. Any narrative implying vast information erasure must confront the corresponding dissipation scale.

We treat ∇S_inf and diffusion-like flux J_inf = -D∇S_inf as analogies that translate assumptions into expected signatures, not as proven laws.

Figure 3.1 — Landauer bound: P_min vs bit erasure rate (illustrative)



4. Toy Dynamical Model: Cost Functional Relaxation

We model 'injected structured anomaly' as periodic increases in a toy cost functional, followed by exponential-like relaxation: C_{n+1} = C_n + inject - alpha*(C_n - C0) + noise. A derived 'relaxation flux' is J = -dC/dn.

Purpose: provide a reference signature (hysteresis-like behavior, cycle dependence) that can be used to validate analysis tools and visual checks. This does not assert a physical substrate; it creates an interpretable synthetic benchmark.

Figure 4.1 — Toy cost relaxation (representative)

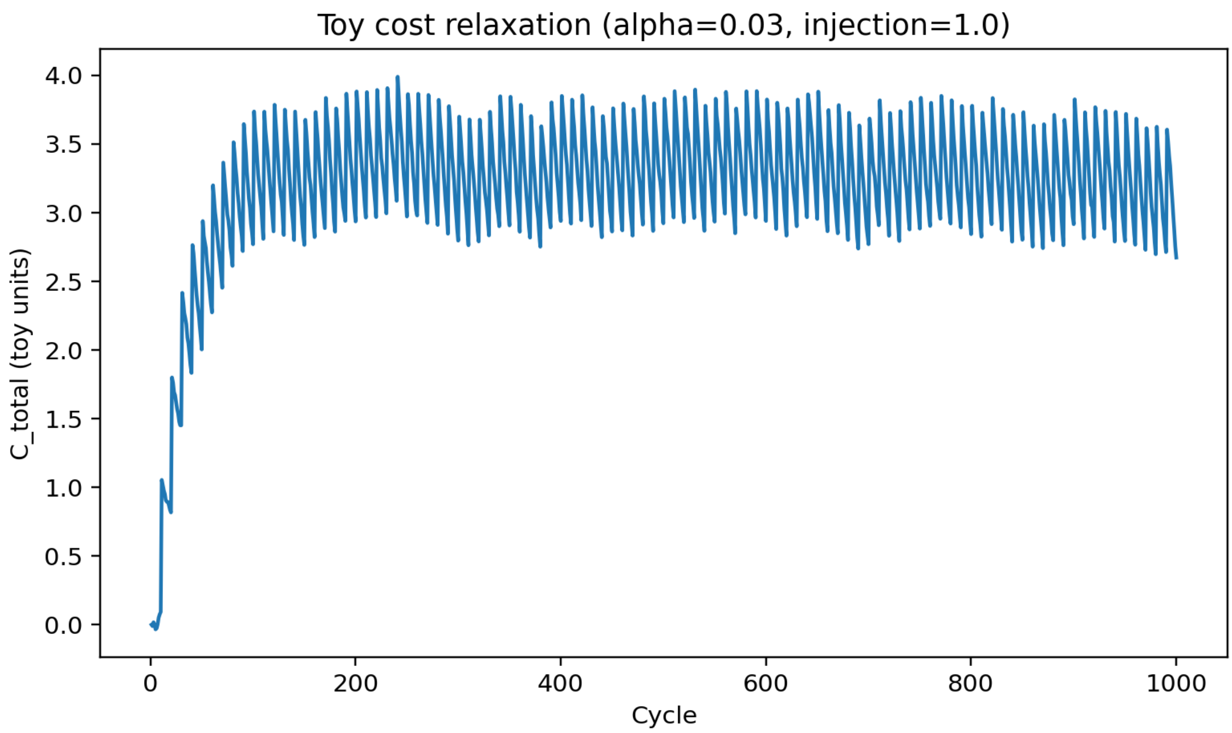
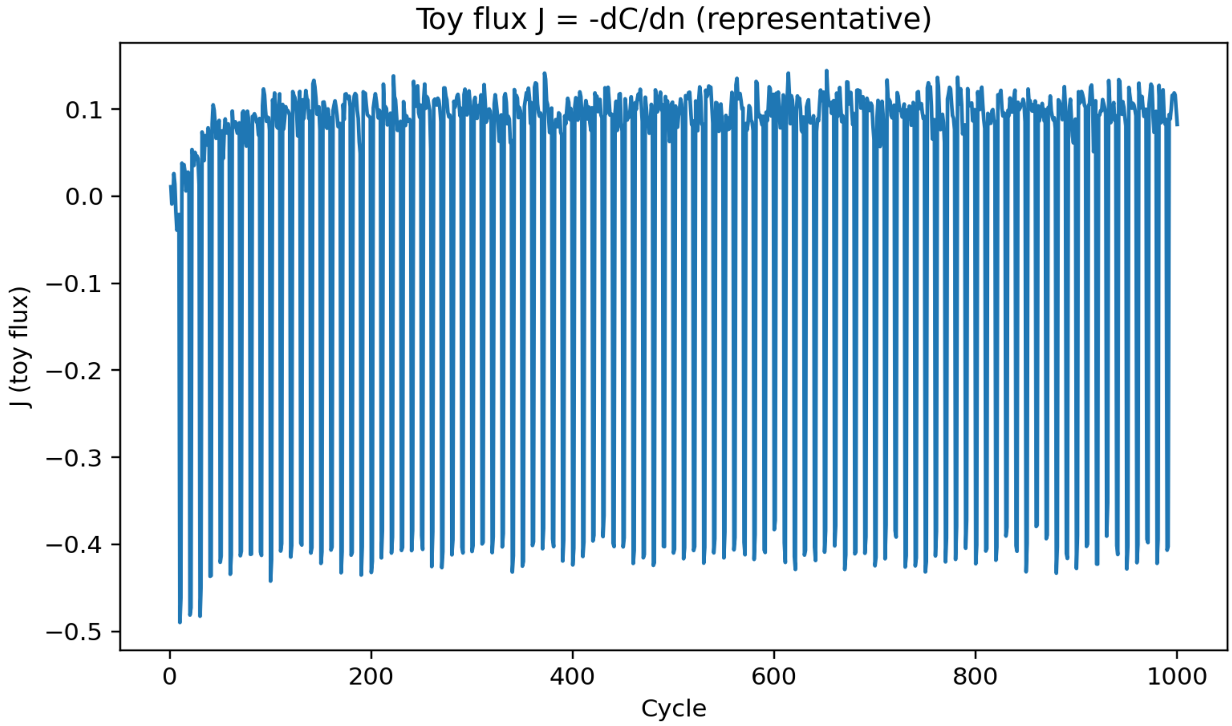


Figure 4.2 — Derived flux J = -dC/dn (representative)

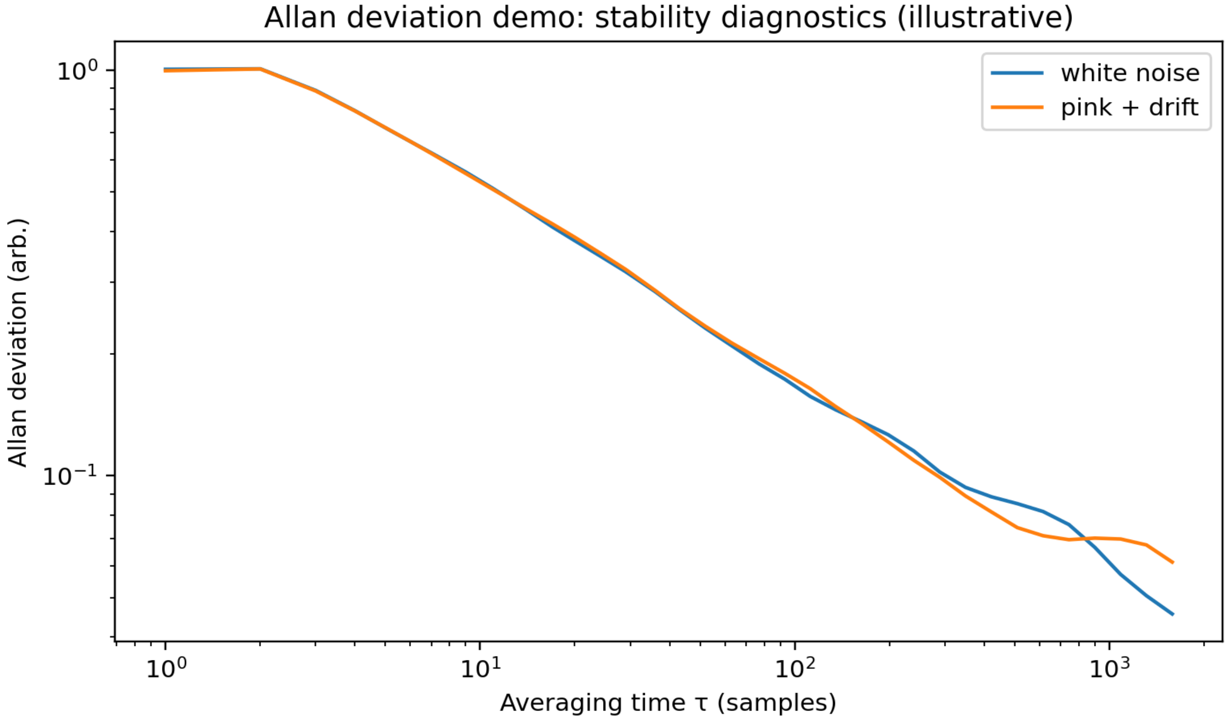

Toy flux J = -dC/dn (representative)
J (toy flux)
0.1
0.0
−0.1
−0.2
−0.3
−0.4
−0.5
0
200
400
600
800
1000
Cycle

5. Metrology: Noise, Drift, and False Positives

Real experiments are dominated by drift and correlated noise (1/f, environmental coupling). ON/OFF toggling can produce apparent mean shifts even when no true effect exists. We therefore require Monte Carlo baselines, permutation tests, and drift-aware regression.

Allan deviation is a crucial tool for stability diagnosis; PSD helps identify noise colors and resonances. Both should be computed routinely.

Figure 5.1 — Allan deviation demo (white vs pink+drift)



6. Monte Carlo Baselines for Spurious ON/OFF Effects

We simulate three scenarios: white-only noise with low drift, pink noise with low drift, and pink noise with higher drift. The resulting distribution of apparent ON/OFF effects provides a baseline for false-positive risk estimation.

Figure 6.1 — white_only_low_drift

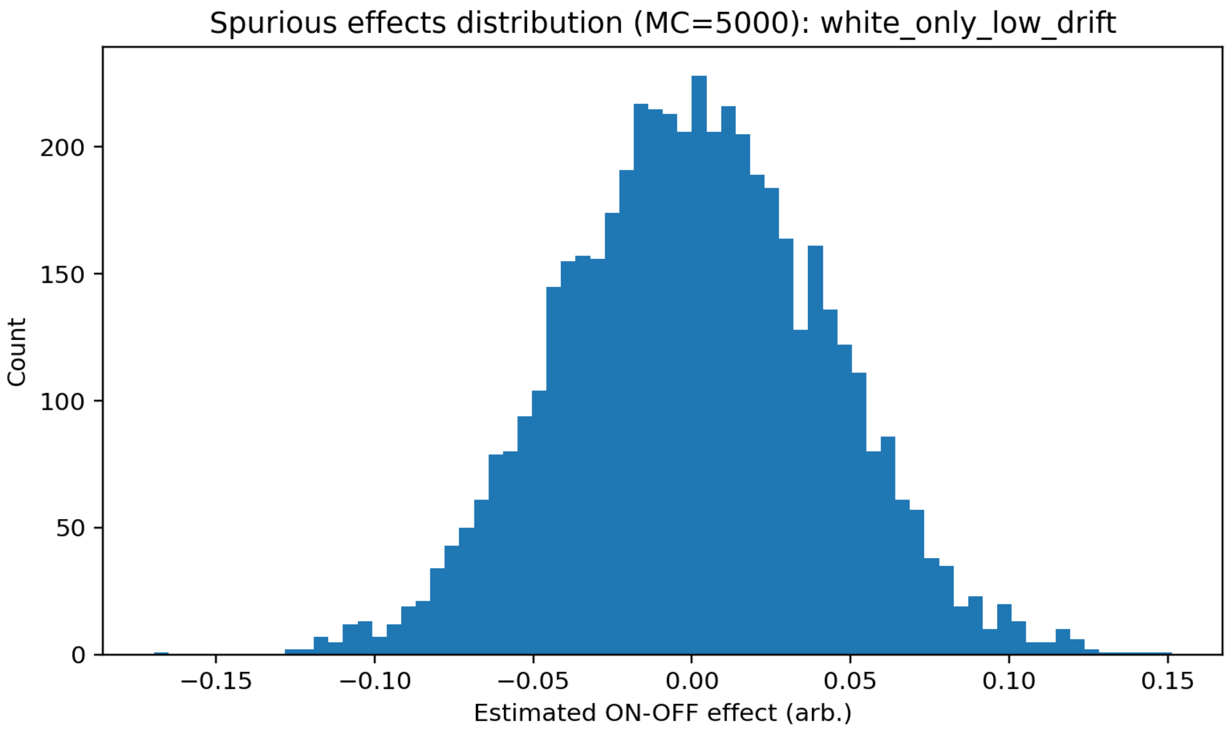


Figure 6.2 — pink_low_drift

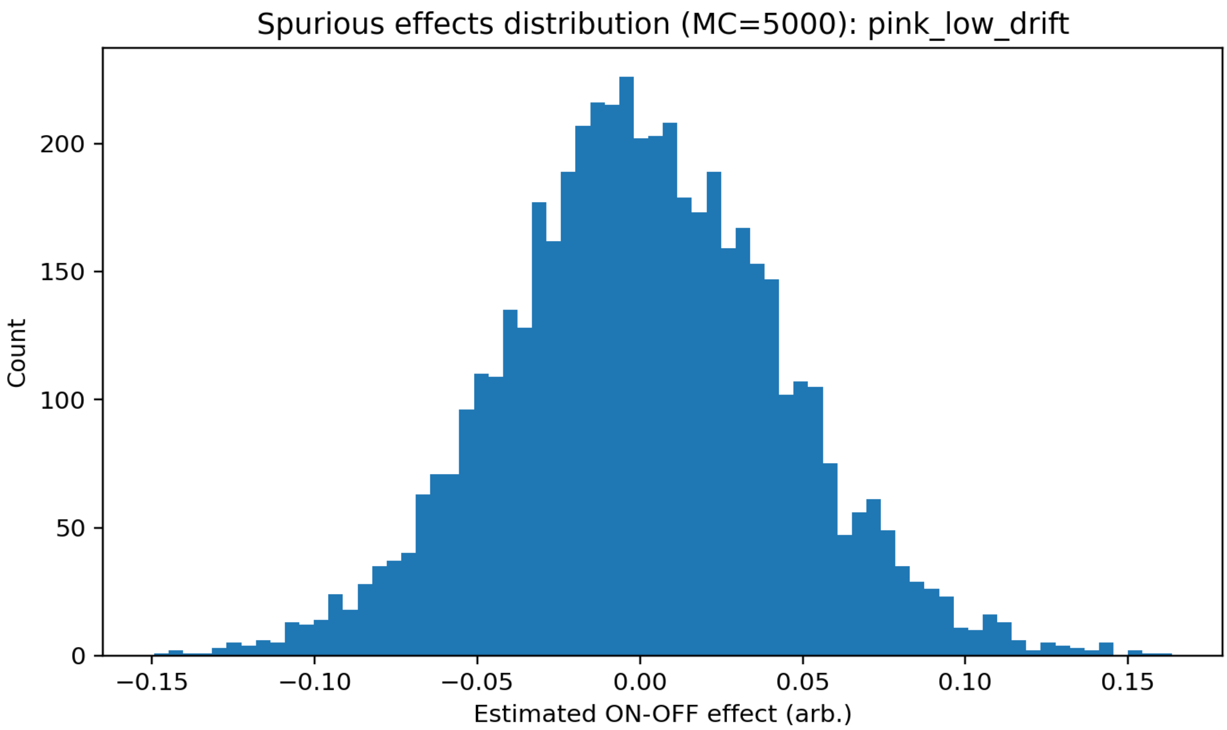
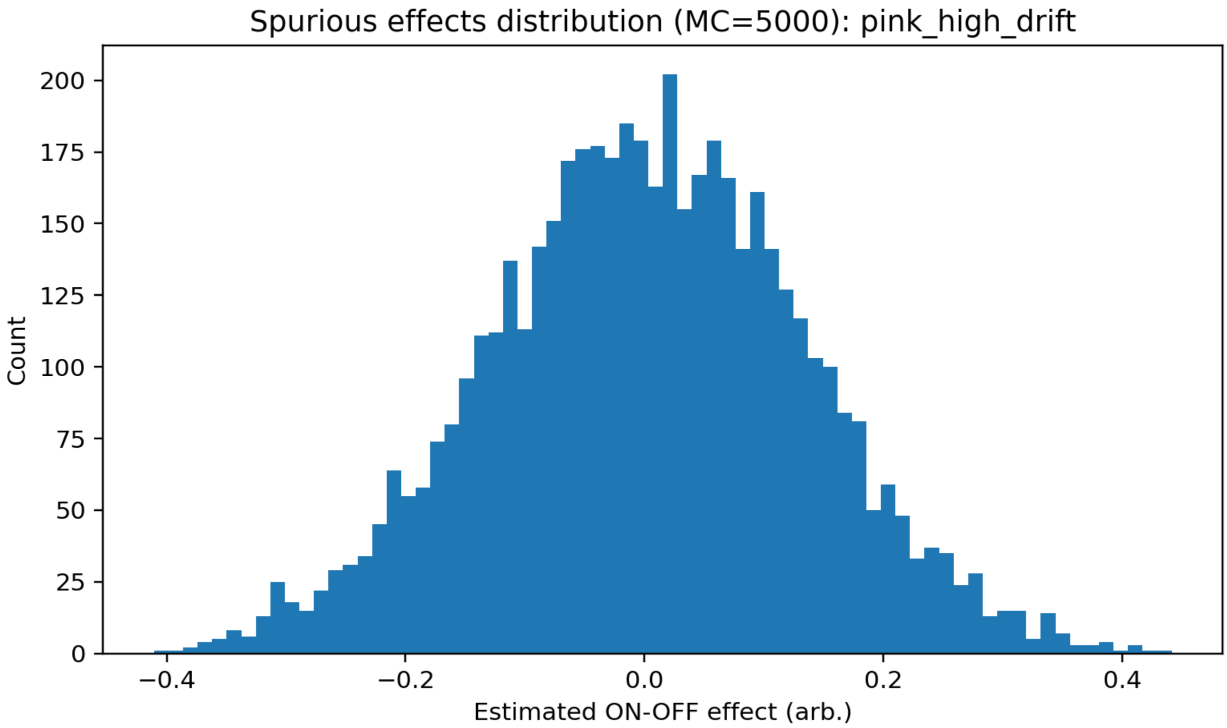


Figure 6.3 — pink_high_drift



7. Statistical Protocols: Permutation Tests and Confound Regression

Permutation tests provide non-parametric p-values by shuffling labels. They are essential when noise is non-Gaussian or correlated.

Confound regression: if a sensor is correlated with temperature or time, regress the sensor on confound proxies and analyze residuals. If the effect vanishes on residuals, it was likely conventional drift.

Figure 7.1 — Confound example: raw sensor dominated by temperature drift

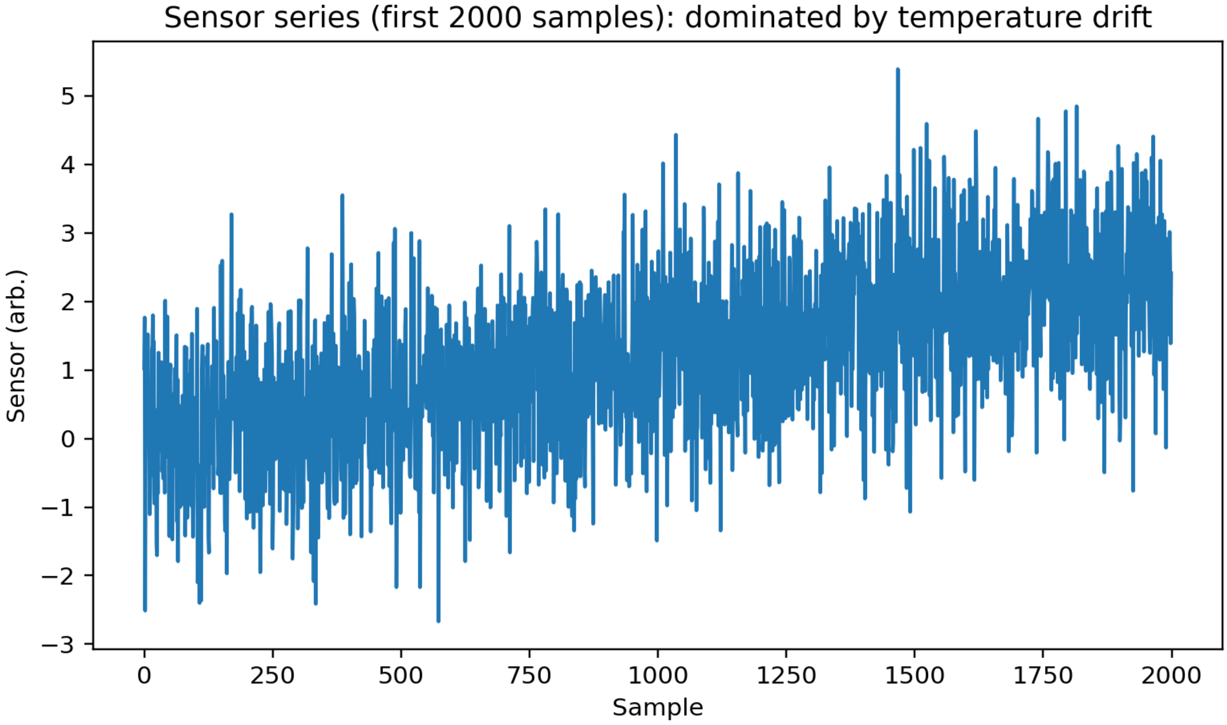
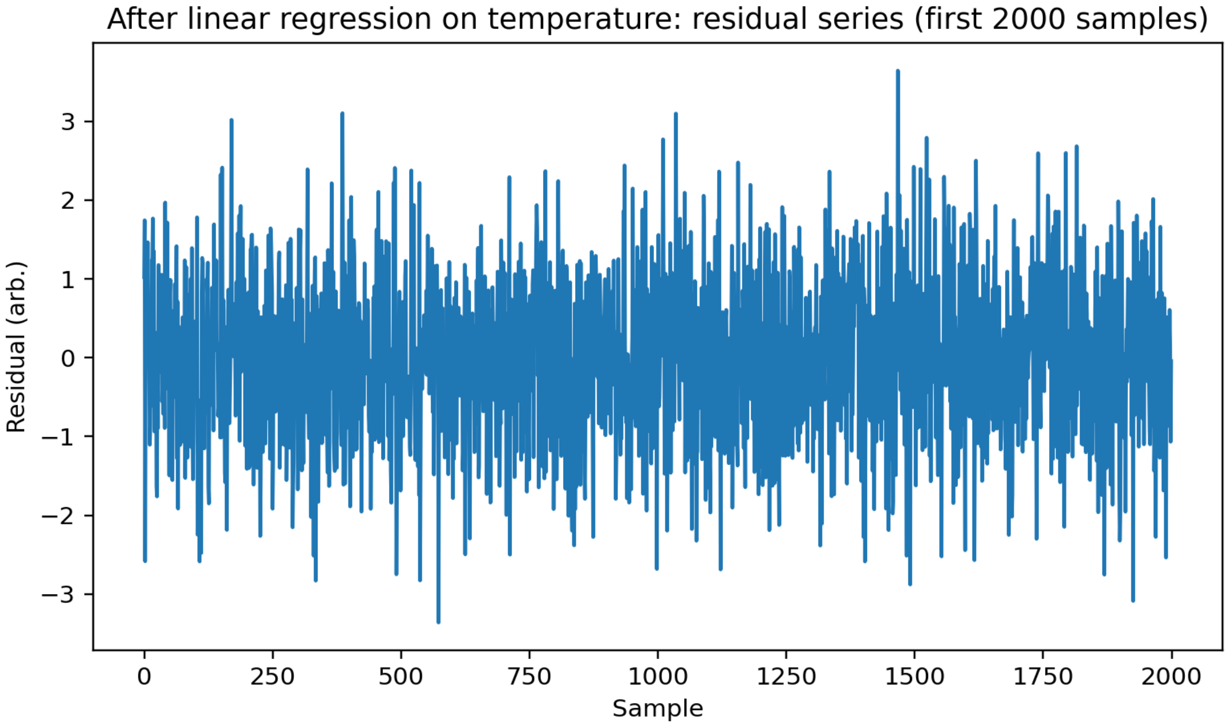


Figure 7.2 — After regression on temperature: residual series


After linear regression on temperature: residual series (first 2000 samples)
Residual (arb.)
3
2
1
0
−1
−2
−3
0
250
500
750
1000
1250
1500
1750
2000
Sample

8. Falsification Gates and Stop Conditions

We formalize staged gates G0–G5. A claim cannot advance without passing prior gates. This is the central mechanism that protects the research from motivated reasoning.

Stop conditions must be declared and enforced: undocumented setup changes, missing metadata, sensor saturation, uncontrolled EMI events, and post-hoc thresholding invalidate the run.

9. Templates and Operational Research Hygiene

Templates included in /docs support preregistration, lab notebook logging, and transparent reporting. The strongest outcome is not a positive claim; it is a cleanly executed, reproducible protocol with honest null results.

Recommendation: keep all raw data immutable; store analysis scripts with exact versions; generate a one-page 'run card' for each experiment run.

10. Safety & Ethics Boundary

The narrative around HGP touches high-risk domains. This pack does not include actionable build steps for hazardous setups. Warnings are not an adequate safeguard against harm. We focus on theory + measurement logic + falsification, which are the scientifically necessary prerequisites anyway.

If public materials are released: separate speculation from established science, publish null results, avoid claims of unlimited energy, and invite independent replication.

Appendix A — Demo Outputs (JSON summary)

Permutation demo (synthetic)

Observed ON/OFF effect: -0.1106, permutation p-value: 0.0003.

Synthetic; illustrates how drift can look significant if not modeled.

Confound regression demo (synthetic)

Naive mean-diff effect: 0.3058. After regression on temperature residuals: 0.0162.

Interpretation: a naive ON/OFF effect can be largely explained by temperature drift coupling.