National Laboratory of the Rockies

RdTools

Keeping a 10-year-old open-source project healthy

Lessons from rdtools

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What rdtools is — and why it matters

An open-source Python library for reproducible analysis of time-series data from solar power plants.

It provides vetted, peer-reviewed analysis routines alongside composable building blocks — with reproducibility as the design priority, so the same inputs yield the same, defensible results.

- **Degradation — is performance declining?**
- **Soiling — how much energy is lost?**
- **Availability — was the system operational?**

THE VETTED ENGINE BEHIND NATIONAL-SCALE RESEARCH

5,272 systems

>29,000 inverters

>29.7 GW of solar analyzed

Mean system 5.9 MW · mean age 5.6 yrs

Powers **PVFleets** — the DOE PV Fleet Performance Data Initiative — with the same code anyone can **pip install**.

A real, sustained project

2016
first release

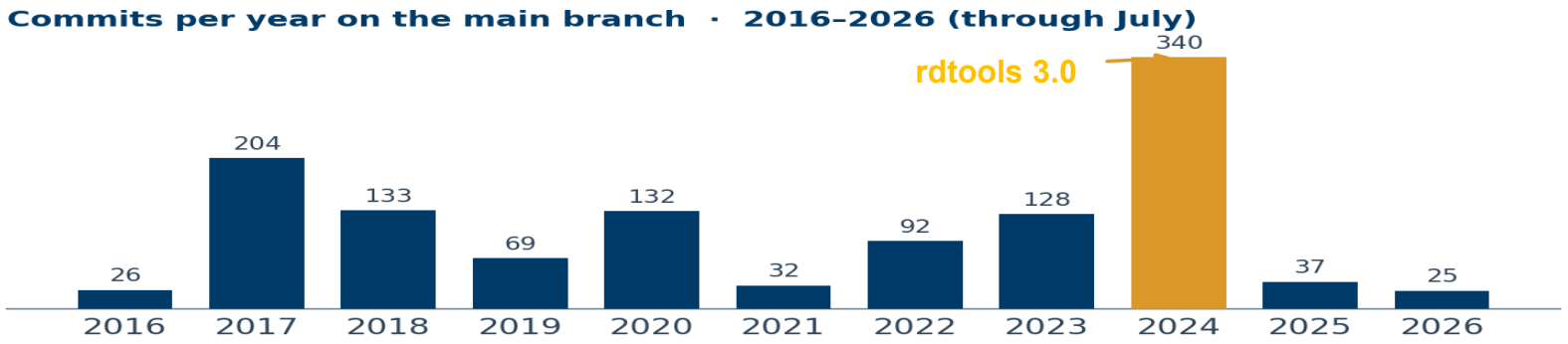
~1,200
commits on main

35
contributors

v3.2.1
latest (2026)

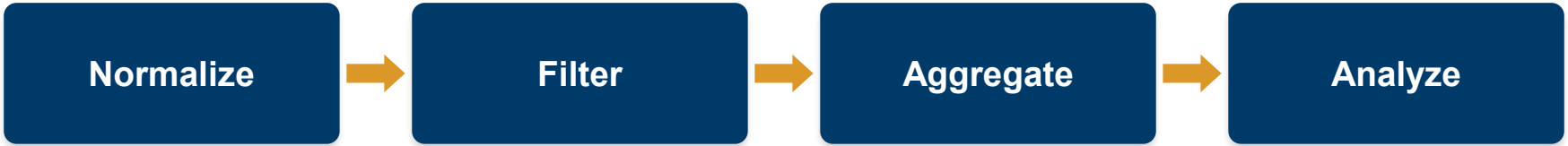
MIT
PyPI + ReadTheDocs

Nearly a decade of sustained, active development — mature enough that the lessons have been tested in practice.



How it's built

The analysis workflow is one simple pipeline — wrapped in a single object, **TrendAnalysis**.



TrendAnalysis — a single guided workflow over the whole chain

MODULES

- degradation
- soiling
- availability
- filtering
- normalization
- plotting

A default workflow — with the primitives still exposed — serves both newcomers and power users.

Engaging contributors & users

THEME 1 · LOWERING THE BARRIER

Reproducible environments (pixi + lockfile)

A single lockfile resolves identically on a laptop and on the HPC — and lets us reproduce a prior analysis with the exact package versions.

Documentation + runnable example notebooks

Users learn by example; contributors gain a starting point. The notebooks serve three roles at once: documentation, tests, and onboarding.

A clear contribution path

A development-branch workflow, issue and PR templates, and PEP8 + NumpyDoc conventions — drawing national-lab, industry, and academic contributors.

Removing as many barriers as possible to turn passive users into active contributor.

Maintaining OSS in the age of AI

THEME 2 · CODING AGENTS AT WORK

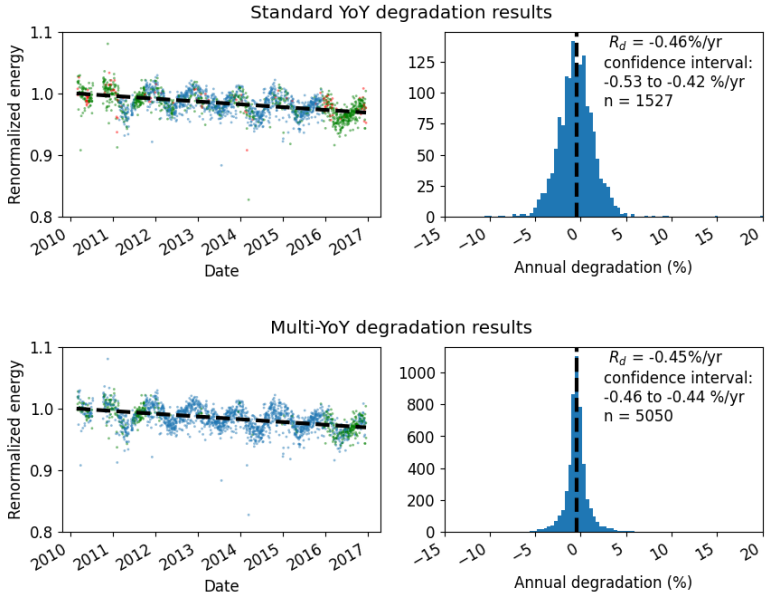
Rather than managing a flood of AI-generated PRs — we use coding agents to sustain and modernize a niche library.

- ✓ **Substantially reduced development time on recent releases (v3.x.x)**
- ✓ **Accelerated first-pass pull-request review**
- ✓ **Made modernization tractable — e.g. the migration to pixi**

Safe because the checks already existed: tests + CI (Codecov), reproducible lockfiles, notebook validation (nbval), human-review PR checklist.

New feature highlight!

multi-yoy of degradation analysis



Shipped in an agent-assisted cycle: multi-year-on-year degradation. On the same dataset, the confidence interval narrows from ±0.05 to ±0.01 %/yr (n = 1,527 → 5,050).

Collaboration among OSS projects

THEME 3 · A SHARED ECOSYSTEM

Doing the foundational methods in the open — and depending on the ecosystem — is what gives a small library real reach.

AI coding agents

A maintainer’s perspective

A small-team effort — not an army.

- Thin bandwidth, and a real bus-factor risk.
- A relentless dependency & version treadmill.

What changed for me: coding agents.

- They speed up the work — faster releases and fixes.
- Code quality has jumped with the latest models significantly.
- They handle the mundane well — like writing tests.

VS Code + Copilot
in-editor completions & quick edits

Claude Code
agentic, multi-file work · CUI-approved models (via LiteLLM)

Takeaways for maintainers

1

Build the guided path

Reproducible environments, a clear default workflow, and runnable documentation lower the barrier for contributors — and let agents operate safely.

2

Let agents carry maintenance

For small teams, the greatest value of AI is sustaining essential maintenance — because tests and reproducibility let you verify the output.

3

Compose, don't conquer

Depend on the ecosystem, implement methods in the open, and collaborate across organizations — so a small library can support large-scale work.

Takeaways: make it trivial to reproduce your project and verify a change — that is what makes both AI tools and collaborators dependable.

RdTools

Get started

install pixi *https://pixi.prefix.dev/latest/installation/*

clone the repo *github.com/NatLabRockies/rdtools*

pixi run lab

www.nlr.gov | martin.springer@nlr.gov

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