Radial Climatological Rings Chart (Python)

Concentric “seasonality rings” for monthly data. Each ring is a year (inner = most recent), and each ring has 12 wedges (Dec at 12 o’clock, Jan at 1 o’clock, …, Nov at 11 o’clock). Designed for anomalies **and** absolute values (e.g., CO_2), with smart color scaling, publication-ready output, and a friendly CLI.

✨Features

- **Rings by year**: inner = latest, outer = earliest.
- **Clockwise month layout**: **Dec at 12 o’clock**.
- **Smart color scaling**:
- *Smart symmetric* (default): auto-detects if data crosses 0; uses symmetric scale for anomalies, non-symmetric otherwise.
- Optional robust min/max via quantiles.
- Exact colorbar step control (e.g., **0.1**), with automatic **tick thinning** to avoid over-plotting.
- **Aligned colorbar**: ticks and segment boundaries line up.
- **Month labels** around the outside.
- **Configurable year axis**: angle, tick spacing, label offset, bold font, widths.
- **Headless**: saves straight to PNG; no GUI window.

🌳Quick start

```
# 1) Install dependencies (Python 3.9+)
pip install numpy pandas matplotlib

# 2) Run on an anomaly dataset
python seasonal_ring_chart.py
  --data HadSST.4.2.0.0_monthly_GLOBE.csv
  --value-col anomaly --year-col year --month-col month
  --year-min 1970 --year-max 2025
  --title "Global SST anomaly (HadSST4)"
  --hide-center-label --month-labels
  --year-axis-angle-deg 165 --year-label-step 10
  --cbar-step 0.1 --cbar-shrink 0.8 --cbar-fraction 0.045 --cbar-pad 0.03
  --year-label-fontsize 6 --year-label-weight bold --year-label-offset 0.22
  --year-axis-linewidth 1.4 --year-tick-width 1.4 --year-tick-length 0.10

# 3) Run on a positive-only dataset (e.g., CO₂ ppm)
python seasonal_ring_chart.py
  --data co2_mm_mlo.csv
  --value-col average --year-col year --month-col month
  --year-min 1970 --year-max 2025
  --title "Mauna Loa CO₂ (ppm)"
  --hide-center-label --month-labels
  --year-axis-angle-deg 165 --year-label-step 10
  --cbar-shrink 0.6 --cbar-fraction 0.05 --cbar-pad 0.03
  --year-label-fontsize 8 --year-label-weight bold --year-label-offset 0.20
  --year-axis-linewidth 1.2 --year-tick-width 1.2 --year-tick-length 0.10
```

The script auto-picks sensible colorbar steps when `--cbar-step` is omitted and caps the number of segments/ticks to keep plots crisp.

🦏Installation

- Python **3.9+**
- `pip install numpy pandas matplotlib`

Optional: create and activate a virtualenv/conda env before installing.

🐈Usage

```
python seasonal_ring_chart.py --data <file.csv> --value-col <name> --year-col
<name> --month-col <name> [options]
```

Data expectations

- CSV with at least **year**, **month**, and **value** columns.
- Month can be **1–12** or strings (e.g., `Jan`, `January`). Use `--month-format` if needed.
- Missing months are drawn in a neutral grey.

Month layout

- The plot is rotated so **December sits at 12 o'clock** (top). January is at roughly 1 o'clock, etc.

🦝Most useful options (short list)

- `--year-min/--year-max` : clamp the time window.
- `--hide-center-label` : remove the center text.
- `--month-labels` : draw month labels around the outside (default on).
- `--year-axis-angle-deg 165` : place year axis between **Sep & Oct**.
- `--year-label-step 10` : label every 10 years (also controls tick placement).
- `--year-label-offset 0.2` : nudge labels away from the axis line.

- `--year-axis-linewidth/--year-tick-width/--year-tick-length` : styling for the year axis.
- `--cbar-step 0.1` : force exact colorbar step (segments & labels aligned).
- `--cbar-shrink 0.8` and `--cbar-fraction 0.045` : colorbar length & thickness.

  See **User Manual** for the full option reference.

🐞Output

- Always saves a PNG (default filename: `seasonal_ring_chart_<value>_<firstYear>-<lastYear>.png`).
- `--save out.png` to set the filename.
- `--dpi 600` by default for publication quality.

💐Tips

- For **reproducible color scales across runs**, provide `--vmin/--vmax`.
- For small anomaly ranges, `--cbar-step 0.1` looks clean.
- If labels feel crowded, increase `--year-label-step`, reduce `--year-label-fontsize`, or tweak `--month-label-fontsize`.
- Very long year ranges: consider shrinking `--ring-width` or increasing `--figsize`.

🍁Development

- No GUI: the script sets `matplotlib` to the **Agg** backend.
- Layers: data wedges at low z-order; labels/axis on top (prevents the center hole from hiding labels).
- Complexity: O(12 × years). Even large datasets should render quickly.

Contributing

Issues and PRs welcome! Please include a minimal CSV sample and the exact command you ran.

🦤License

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