Methods — Deriving a Daily UV-Dose Schedule that Links McMurdo Field Data to Chamber Grids

1. **Field dataset acquisition**
   Downloaded from NOAA's SUV‑100 Version 2 archive (folder MCM_v33.2_…).
   - Database **DB3_meas** → spectral integrals:
     • E 290–315 nm (UV-B) • E 315–400 nm (UV-A).
   - Seasonal window **15 Dec 2023 – 15 Jan 2024** (clear-sky Antarctic midsummer).
   - Kept scans whose **Flags** column is blank (instrument-QC pass).
2. **Convert scans to hourly means**
   Instrument records ~20-min spectra; three scans/hour were averaged.
   Units retained: mW cm^{-2}.
   $P_{h,\text{band}}=\text{mean}{i=1..3}\,P{i,h}$
3. **Pick the ten brightest days**
   Daily UV-B dose = Σ hourly_power × 3600 s
   • Resampled to 1-day bins; kept the **10 largest** UV-B daily doses.
4. **Build field reference powers**
   - Grand-average **24-row profile**: mean of each UTC hour across the ten days.
   - **24-h mean powers** used downstream:
     $P_{\text{MDV,UVA}} = 2.2671\;\text{mW cm}^{-2},\quad P_{\text{MDV,UVB}} = 0.0341\;\text{mW cm}^{-2}$
     Field daily dose (energy):
     $D_{\text{MDV}}=P_{\text{MDV}}\times24\;h\times3600\;s.$
5. **Measure chamber grids**
   Ten grids under the UV array were mapped with a Solarmeter 5.0.
   - Raw readings corrected by the manufacturer's **spectral-response CSV** (response = 100 % at 370 nm; scaled down at shorter λ).
   - Warm-up-averaged UV-B power (0–60 min) and steady UV-A power recorded; units after correction: mW cm^{-2}.
   - File chamber_vs_MDV_24h.csv stores:
     grid, P_UVA, P_UVB, factor = P_MDV / P_chamber.
6. **Reference grid and lamp times**
   *Grid **3** chosen to anchor UV-B.*
   UVA_HOURS is user-set (default **24 h**).
   If UVB_HOURS_OVERRIDE is **None** ⇒
   $t_{\text{Hg}} = 24\,h\; \frac{P_{\text{MDV,UVB}}}{P_{\text{grid3,UVB}}}$
   (= 1.06 h with current powers).
   If a value is supplied, it is used verbatim.
7. **Daily chamber doses**
   For each grid g:
   $D_{g,\text{UVA}} = P_{g,\text{UVA}}\times t_{\text{LED}}\times3600$
   $D_{g,\text{UVB}} = P_{g,\text{UVB}}\times t_{\text{Hg}}\times3600$

Percent of MDV dose:
$\%D = 100\times \frac{D_g}{D_{\text{MDV}}}$

8. **Generate the dose calendar**
   The script
   build_chamber_dose_schedule.py
   - drops duplicate grid rows,
   - keeps full floating-point precision (no rounding in CSV),
   - writes chamber_dose_schedule.csv with explicit units in every header:
9. | grid (#) | UVA_hours (h) | UVB_hours (h) | P_UVA (mW cm^{-2}) | P_UVB (mW cm^{-2}) | MDV_UVA_24h_power (mW cm^{-2}) | … | %MDV_UVA_dose (%) | %MDV_UVB_dose (%) |
10. **Interpretation**
    - Grid 3 now delivers **100 %** MDV UV-B and **≈110 %** MDV UV-A with the default 24 h / 1.06 h lamp times.
    - Grids 1–2 overshoot (good for extreme/Martian tests); grids 5–8 under-dose (shaded controls).
    - Changing UVA_HOURS or supplying UVB_HOURS_OVERRIDE instantly revises every %MDV value, allowing one-line optimisation of lamp schedules.

All calculations are unit-consistent (power mW cm^{-2} → energy mJ cm^{-2}) and reproducible using the CSVs in the project directory.