

Q-CODA

INPUT DATA

- Daily precipitation total P_d
- Historical hourly precipitation records

STEP 1

Apply Comonotonic Transformation

$$P_{\tau}^{max} = F_{P_{\tau}^{max}}^{-1}(F_{P_d}(x))$$

$$M = (P_{1h}^{max}, P_{2h}^{max}, P_{6h}^{max}, P_{12h}^{max})$$

STEP 2

Initial Pattern Seeding (KNN)

- Search historical daily events with similar P_d (same season)
- Randomly select 1 of the k -nearest events
- Retrieve associated 24-hour precipitation vector $h = (h_1, h_2, \dots, h_{24})$
- Rescale h to match P_d :

$$h \leftarrow h \times \frac{P_d^{target}}{\sum_{i=1}^{24} h_i}$$

$M \& h$

OUTPUT DATA

Final Hourly Series h

- Matches P_d
- Satisfies sub-daily constraints M
- Realistic temporal structure

STEP 3

Iterative Adjustment

- For each $\tau \in \{1h, 2h, 6h, 12h\}$ in h calculate window $I_{\tau} = \{i, \dots, i + \tau - 1\}$ with max sum:

$$S_{\tau}^{max} = \max_{i=1, \dots, 25-\tau} \sum_{j \in I_{\tau}} h_j$$

- Compute discrepancy:

$$\Delta_{\tau} = P_{\tau}^{max} - S_{\tau}^{max}$$

- Adjust h :

$$h_j \leftarrow \max\left(0, h_j + \frac{\Delta_{\tau}}{\tau}\right) \quad \forall j \in I_{\tau}$$

- Repeat until convergence (all $|\Delta_{\tau}| < \epsilon$ or max iterations) and final scaling to match daily total.
- Post-processing: Lag-1 autocorrelation enhancement shifting small pre-rain values forward and permuting within sliding windows to increase temporal coherence while satisfying M