A grid-based data-driven ensemble probabilistic data fusion: a water balance closure approach applied to the irrigated Hindon River Basin, India

Roya Mourad, Gerrit Schoups, and Wim Bastiaanssen

r.mourad@tudelft.nl

TU Delft | Water resources management, Delft University of Technology

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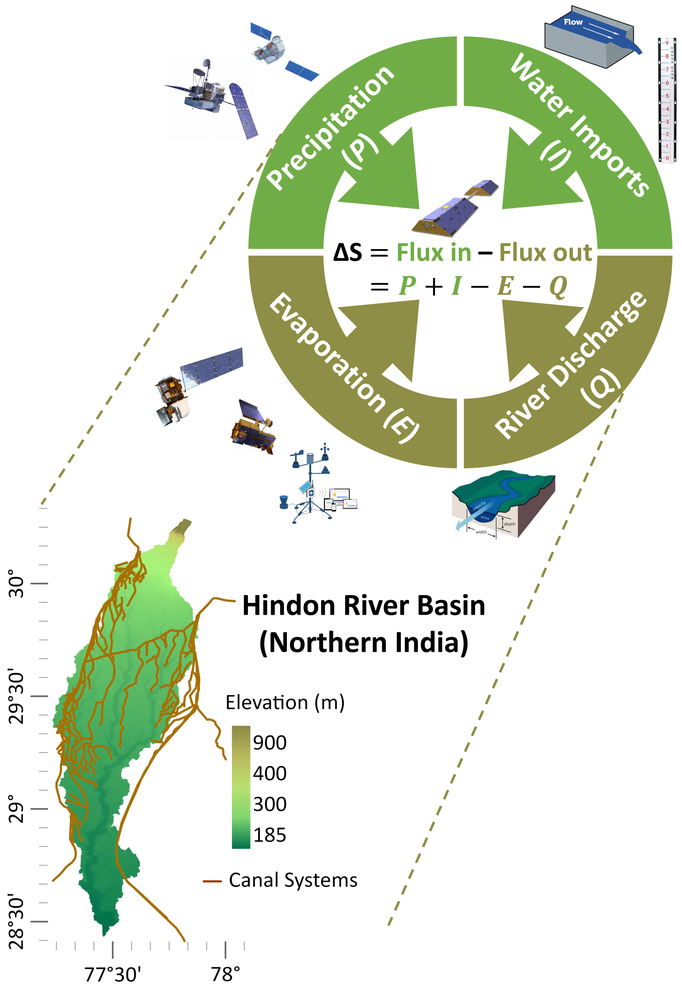
get the abstract

get the code to try it yourself!

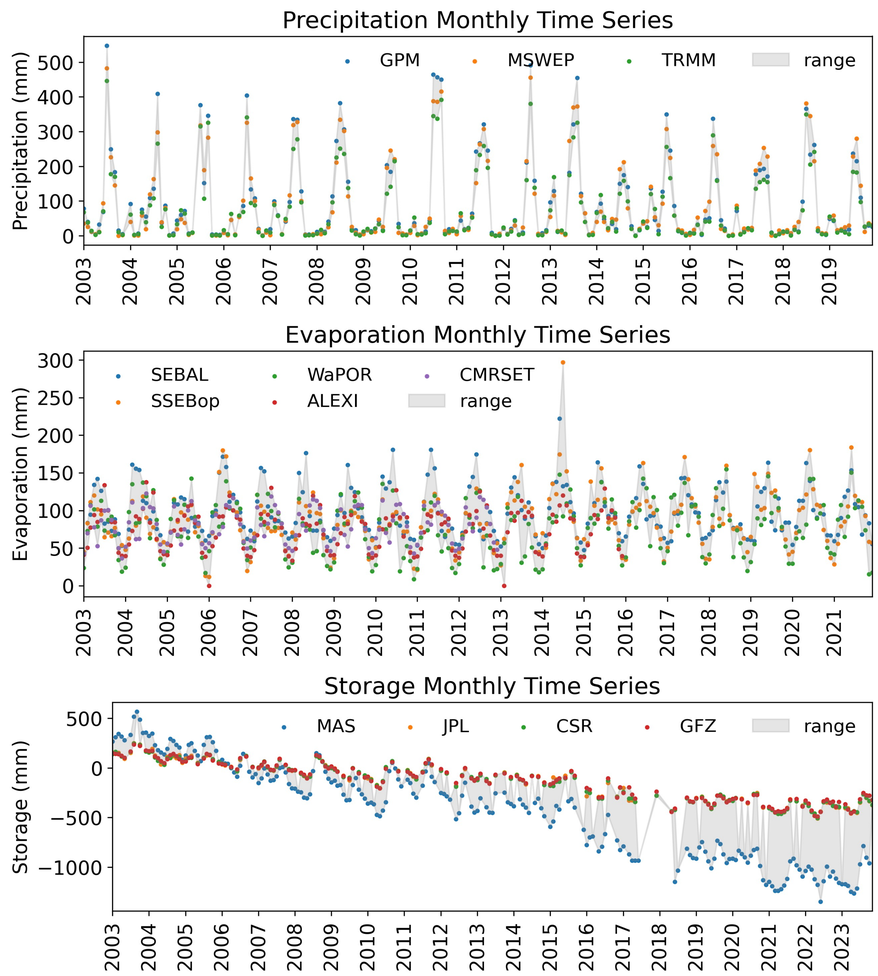
1 Monthly Water Balance (WB)

Goal: Accurate water balance estimation in conjunctively irrigated Hindon Basin



2 Gridded datasets ensembles

Input data: Ensemble-based prior information from remote sensing data for water balance components



3 Probabilistic data fusion

Approach: Prior error models > Inference Engine > Posterior WB estimates < *noise-filtered, bias-corrected*

A BASIN-SCALE ERROR MODELS & DATA FUSION

Error models relate each water balance variable to its "true" value using bias and random error parameters with physical nonnegativity constraint, e.g.,:

- **Prior Evaporation error model:**

$$m_{E,t} = f_E[(1 - w_E)E_{min,t} + w_E E_{max,t}] \leftarrow \textit{Prior mean}$$

$$s_{E,t} = \max\left(0.1 m_{E,t}, \frac{1}{2} r_E \left|E_{min,t} - E_{max,t}\right|\right) \leftarrow \textit{Prior standard deviation}$$

$$E_t \sim \mathcal{N}(m_{E,t}, s_{E,t}^2)$$

$$E_t \geq 0$$

Basin-scale parameters for bias: f_E , w_E , and noise: r_E

- **Inference :** basin-average posterior mean and standard deviation

B GRID-SCALE ERROR MODELS

- **Prior Evaporation error model:**

(i) Set initial values for w_E and r_E

(ii) Implement grid-based error models

Gridded-prior mean $m_{E,t}$, E_{min}, E_{max}

t_0 … t_n: $f_E \cdot [(1\text{-}w_E) \cdot$ ____ $+ w_E \cdot$ ____ $]$

Gridded-prior standard deviation $s_{E,t}$, $m_{E,t}$, E_{min}, E_{max}

max [0.1 • ____ ; ½ • r_E | ____ – ____ |]

C GRID-BASED DATA FUSION

(iii) Compute basin-average posterior means and standard deviations from the grid-based means and standard deviations

(iv) Check if basin-average posterior means & standard deviations calculated from basin-scale data fusion (A) match those from grid-scale averaging **(iii)**

- ✓ **(v)** Grid-scale posteriors consistent with basin-scale posteriors — Yes
- ✗ *Repeat* steps **(i)** to **(iv)** until **(v)** — No