Evaluating simulated discharge in **global hydrological models** from **ISIMIP3a** – preliminary results

Heinicke S, Volkholz J, Schewe J, Sauer I, Mengel M, Frieler K & ISIMIP water modellers

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Background – global water models (ISIMIP2a)

Environmental Research Letters

LETTER

The critical role of the routing scheme in simulating peak river discharge in global hydrological models

Fang Zhao[1,22], Ted I E Veldkamp[2], Katja Frieler[1], Jacob Schewe[1], Sebastian Ostberg[1,3], Sven Willner[1], Bernhard Schauberger[1,4], Simon N Gosling[5], Hannes Müller Schmied[6,7], Felix T Portmann[6], Guoyong Leng[8], Maoyi Huang[8], Xingcai Liu[9], Qiuhong Tang[9], Naota Hanasaki[10], Hester Biemans[11,12], Dieter Gerten[1,3], Yusuke Satoh[13], Yadu Pokhrel[14], Tobias Stacke[15], Philippe Ciais[4], Jinfeng Chang[4], Agnes Ducharne[16], Matthieu Guimberteau[4], Yoshihide Wada[13,17,18,19], Hyungjun Kim[20] and Dai Yamazaki[19,21]

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The critical role of the routing scheme in simulating peak river discharge

Fang Zhao[1,22], T
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LETTER

Worldwide evaluation of mean and extreme runoff from six global-scale hydrological models that account for human impacts

Jamal Zaherpour[1,19], Simon N Gosling[1], Nick Mount[1], Hannes Müller Schmied[2,3], Ted I E Veldkamp[4,18], Rutger Dankers[5], Stephanie Eisner[6], Dieter Gerten[7,8], Lukas Gudmundsson[9], Ingjerd Haddeland[10], Naota Hanasaki[11], Hyungjun Kim[12], Guoyong Leng[13], Junguo Liu[14], Yoshimitsu Masaki[15], Taikan Oki[12,16], Yadu Pokhrel[17], Yusuke Satoh[18], Jacob Schewe[7] and Yoshihide Wada[18]

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LETTER

Worldwide evaluation of mean and extreme runoff from six global-
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Taikan Oki[12,16]

LETTER

Intercomparison of global river discharge simulations focusing on dam operation—multiple models analysis in two case-study river basins, Missouri–Mississippi and Green–Colorado

Yoshimitsu Masaki[1,2], Naota Hanasaki[1], Hester Biemans[3], Hannes Müller Schmied[4,5], Qiuhong Tang[6], Yoshihide Wada[7,8,9,10], Simon N Gosling[11], Kiyoshi Takahashi[1] and Yasuaki Hijioka[1]

Background – global water models (ISIMIP2a)

LETTER • OPEN ACCESS

Evaluation of river flood extent simulated with multiple global hydrological models and climate forcings

Benedikt Mester[3,1,2], Sven Norman Willner[1], Katja Frieler[1] and Jacob Schewe[1]

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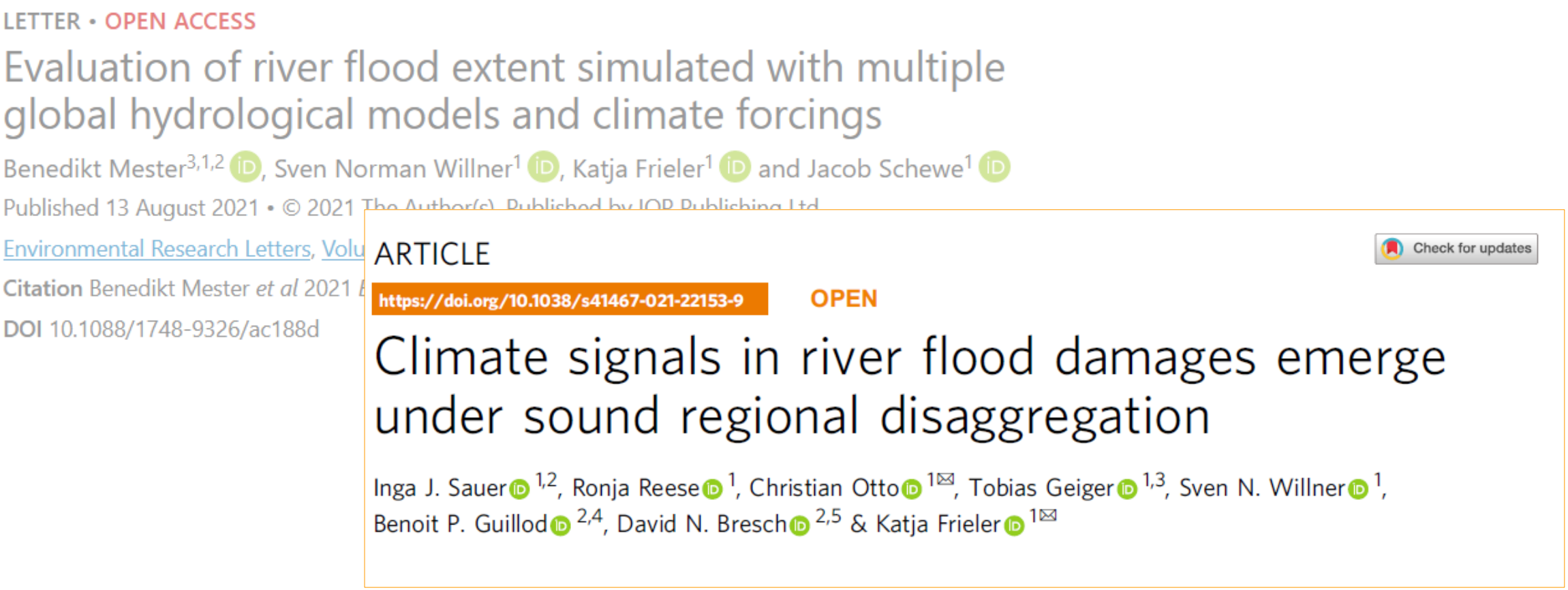
Background – global water models (ISIMIP2a)



LETTER • OPEN ACCESS

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Benedikt Mester[3,1,2], Sven Norman Willner[1], Katja Frieler[1] and Jacob Schewe[1]

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ARTICLE

Check for updates

https://doi.org/10.1038/s41467-021-22153-9 OPEN

Climate signals in river flood damages emerge under sound regional disaggregation

Inga J. Sauer[1,2], Ronja Reese[1], Christian Otto[1✉], Tobias Geiger[1,3], Sven N. Willner[1], Benoit P. Guillod[2,4], David N. Bresch[2,5] & Katja Frieler[1✉]

Motivation – evaluate ISIMIP3a GHMs to inform …

1.) … flood modelling

- Is peak discharge overestimated?
- how well is inter-annual variability of peak discharge simulated?

2.) … attribution studies

- at which stations are models performing well?
- and why?

Approach

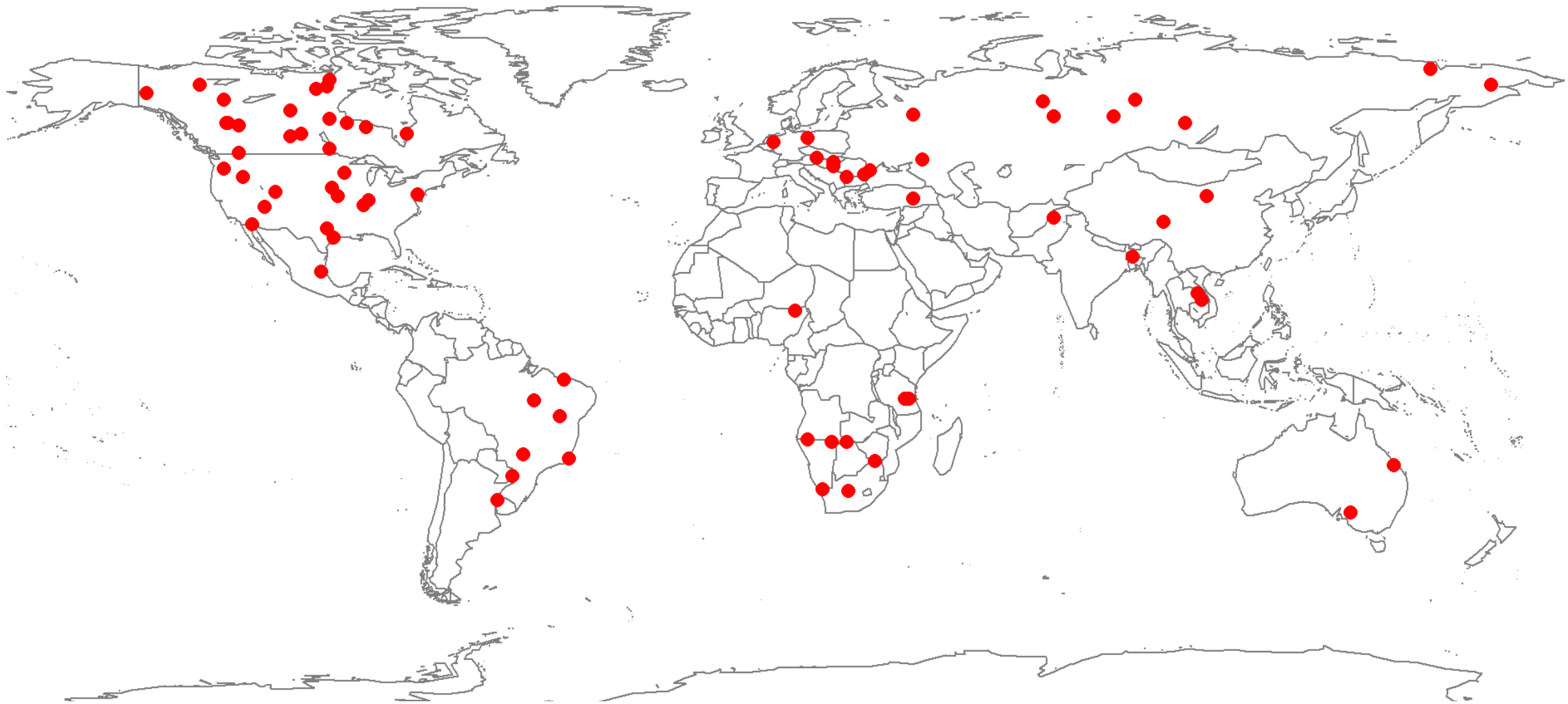
- variable: discharge

- 9 GHMs from ISIMIP3a
  - discharge with model's internal routing scheme
  - runoff modelled by GHMs to drive CaMa-Flood -> discharge

- Observational data
  - from GRDC (Global Runoff Data Centre)
  - 74 stations
    - shown to be compatible with GHMs' routing scheme (Schmied & Schiebener, 2022)

PIK

Approach



Approach

- **daily + maximum annual discharge**

- **evaluation metrics**
  - **correlation (r)**
  - **over/underestimation (percent bias in %)**

Result – daily discharge

Result

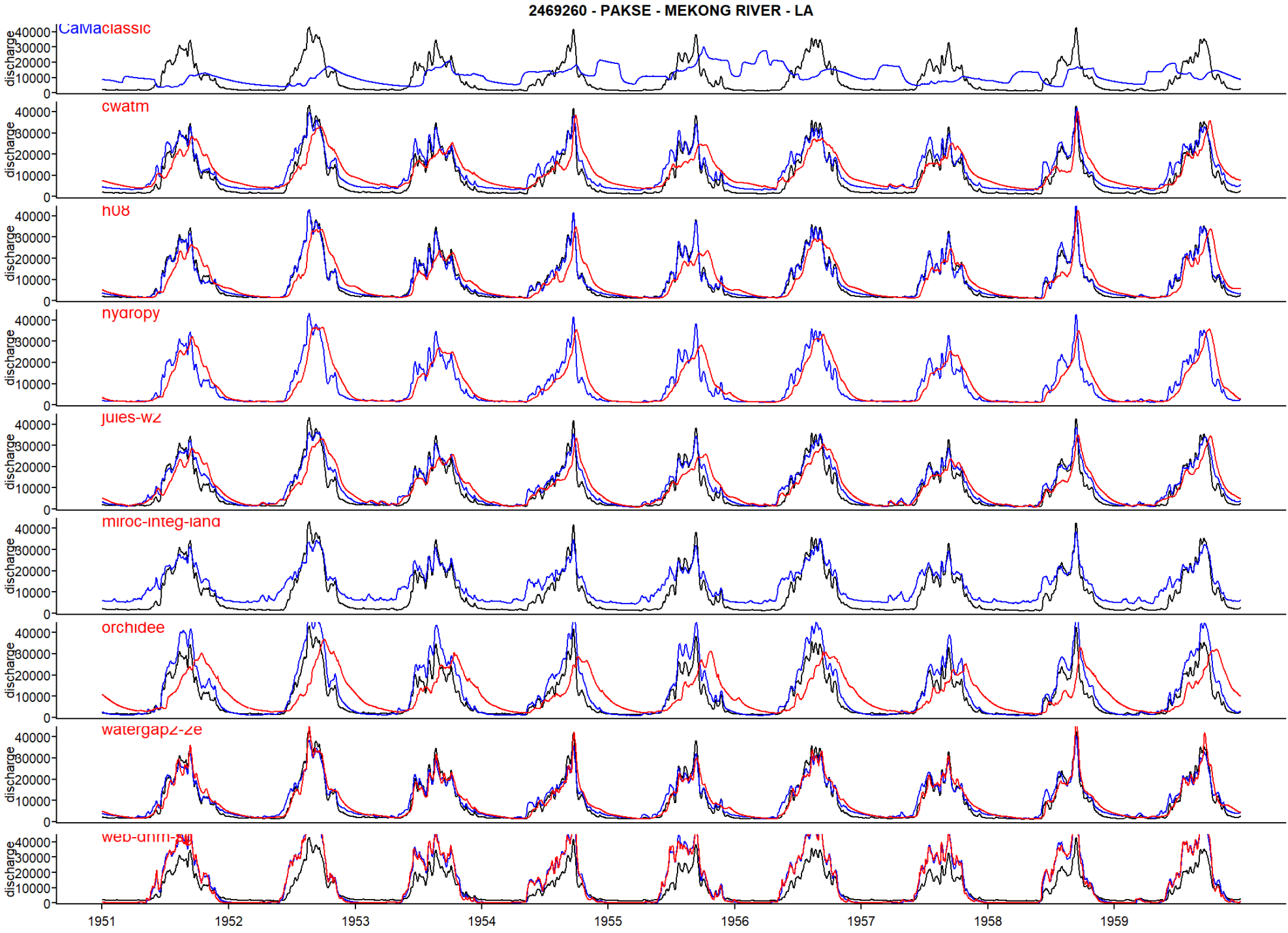
observation

model

routing

CaMa

routing



Result

observatio

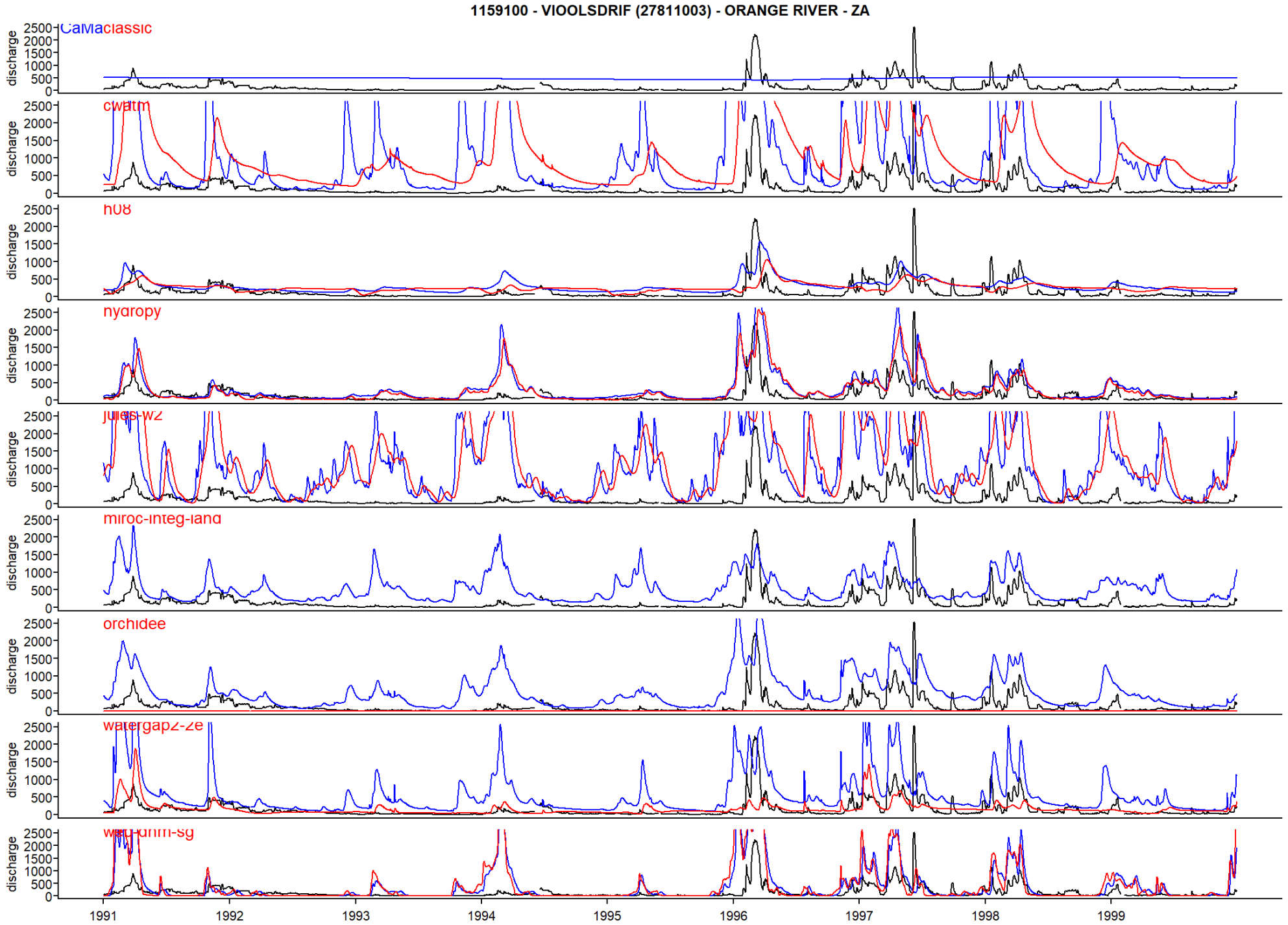
n

model

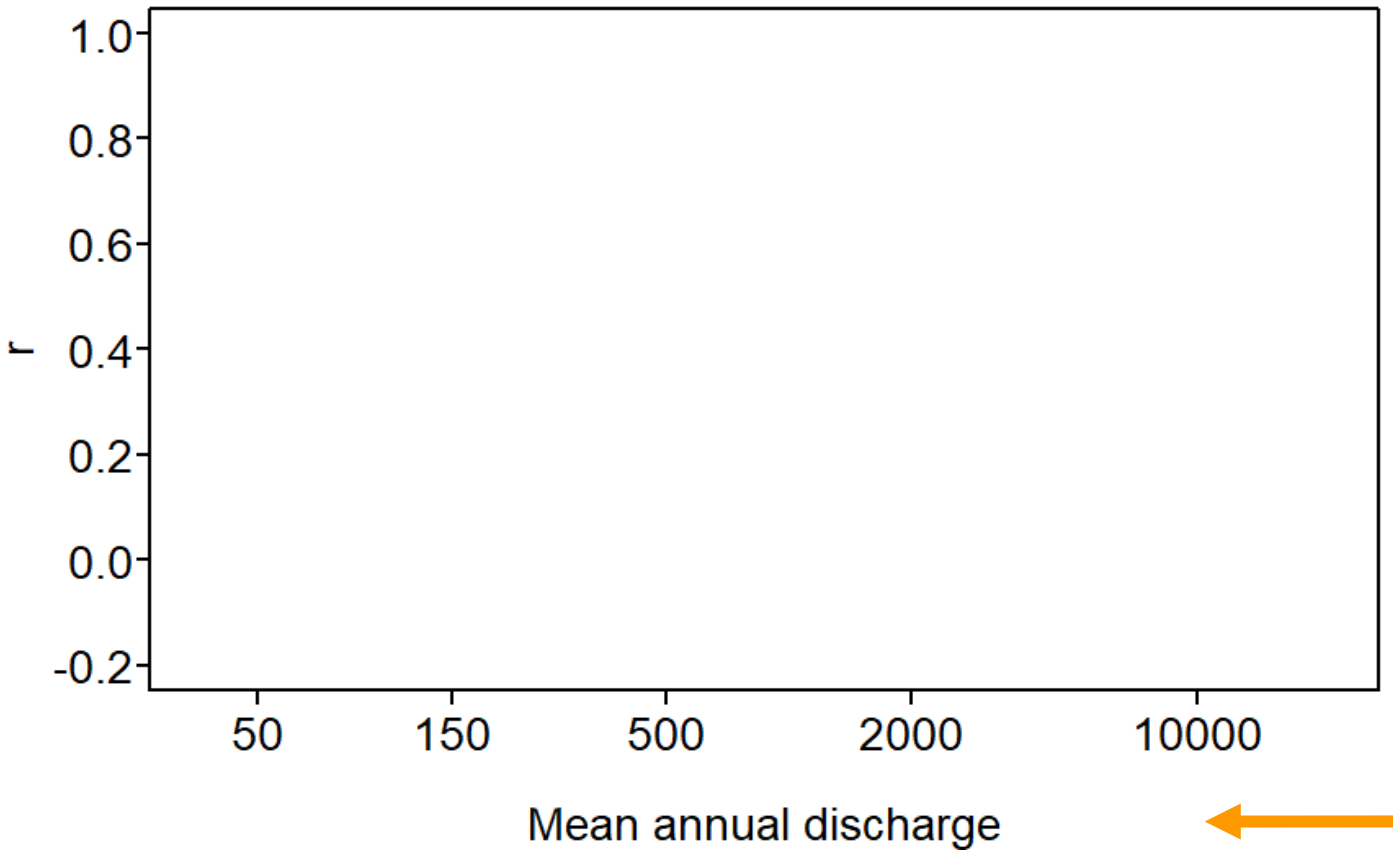
routing

CaMa

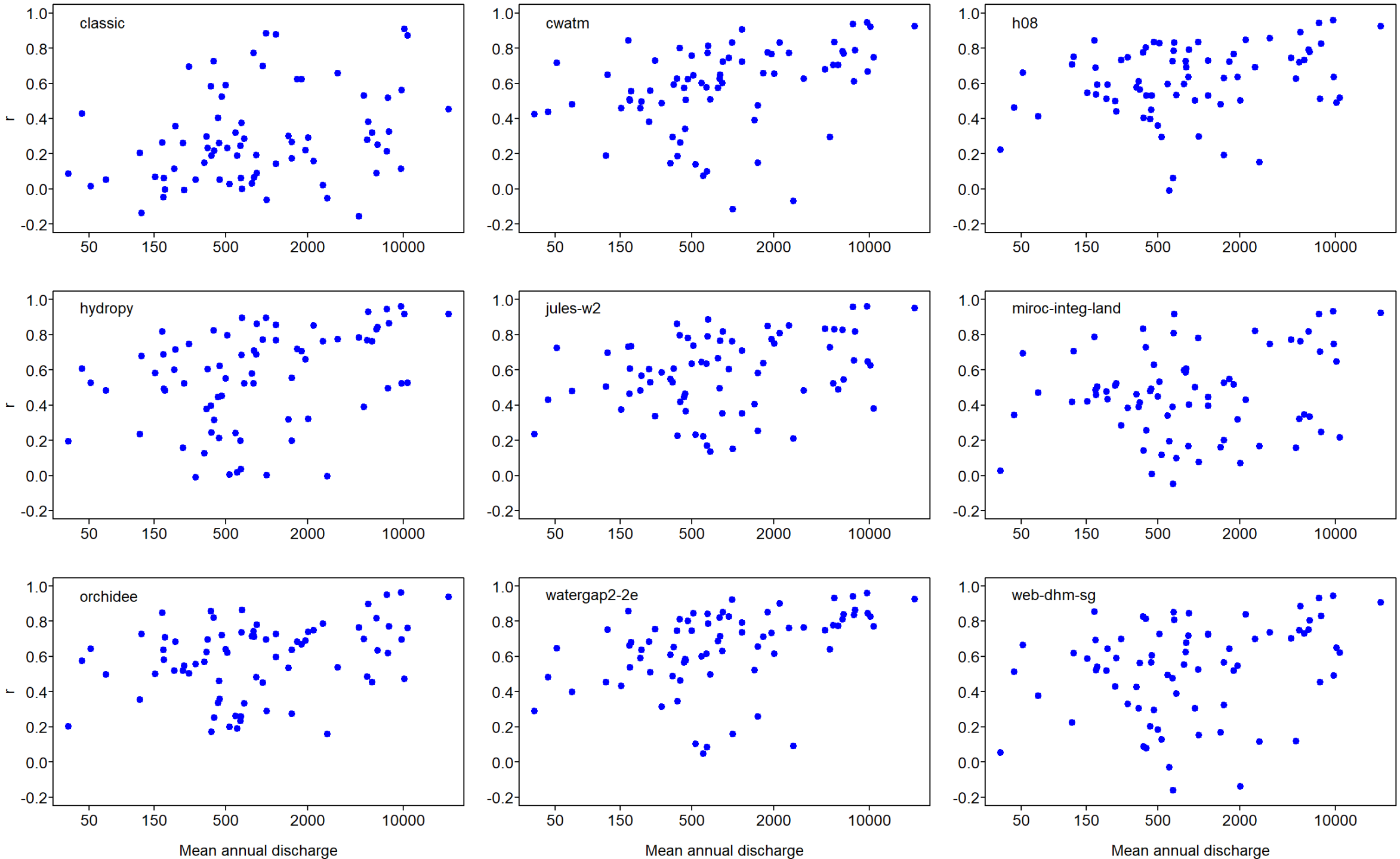
routing



Result: station characteristic vs. model performance



preliminary proxy for aridity/humidity of station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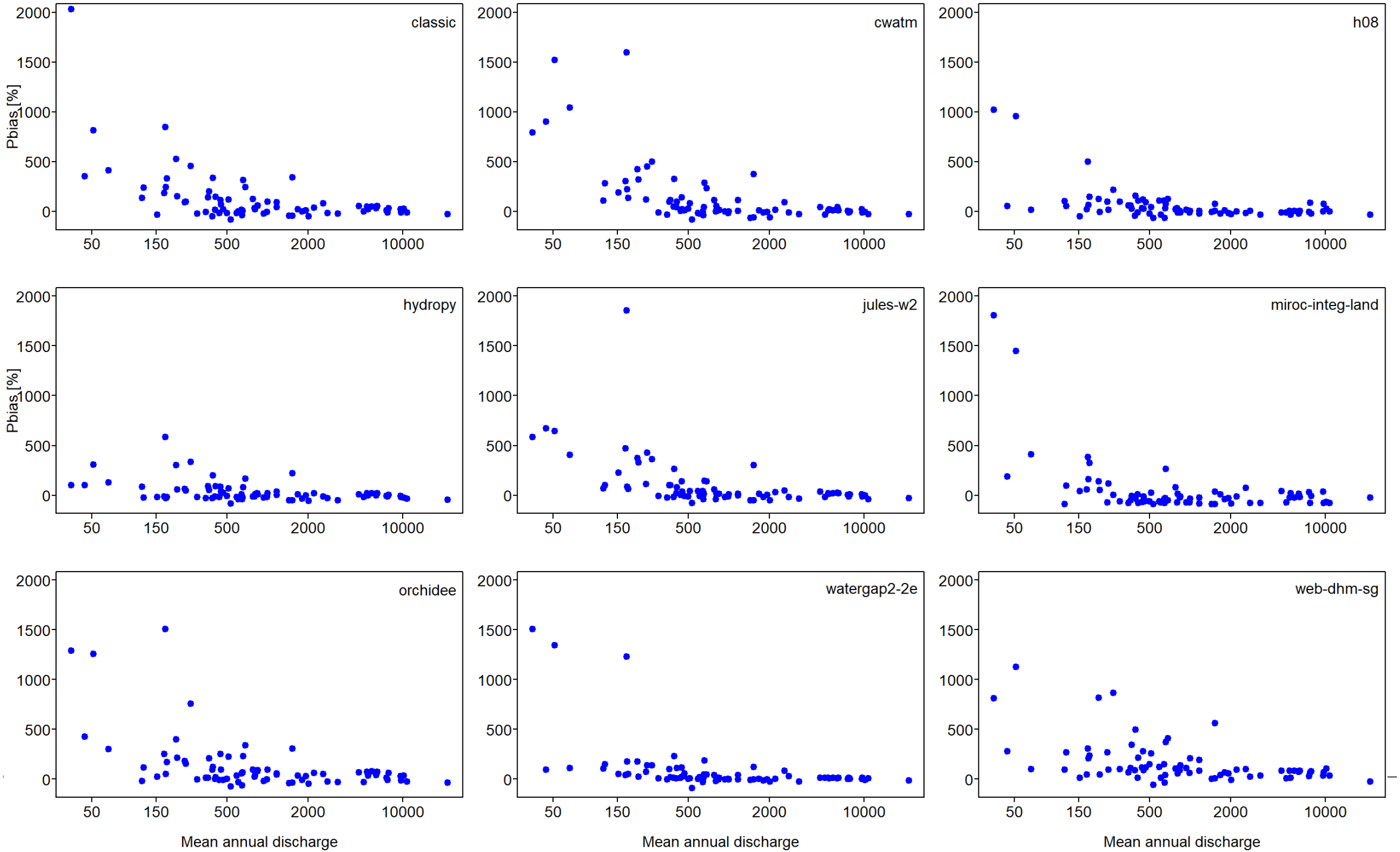
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Pbias [%]
Mean annual discharge
2000
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2000
10000

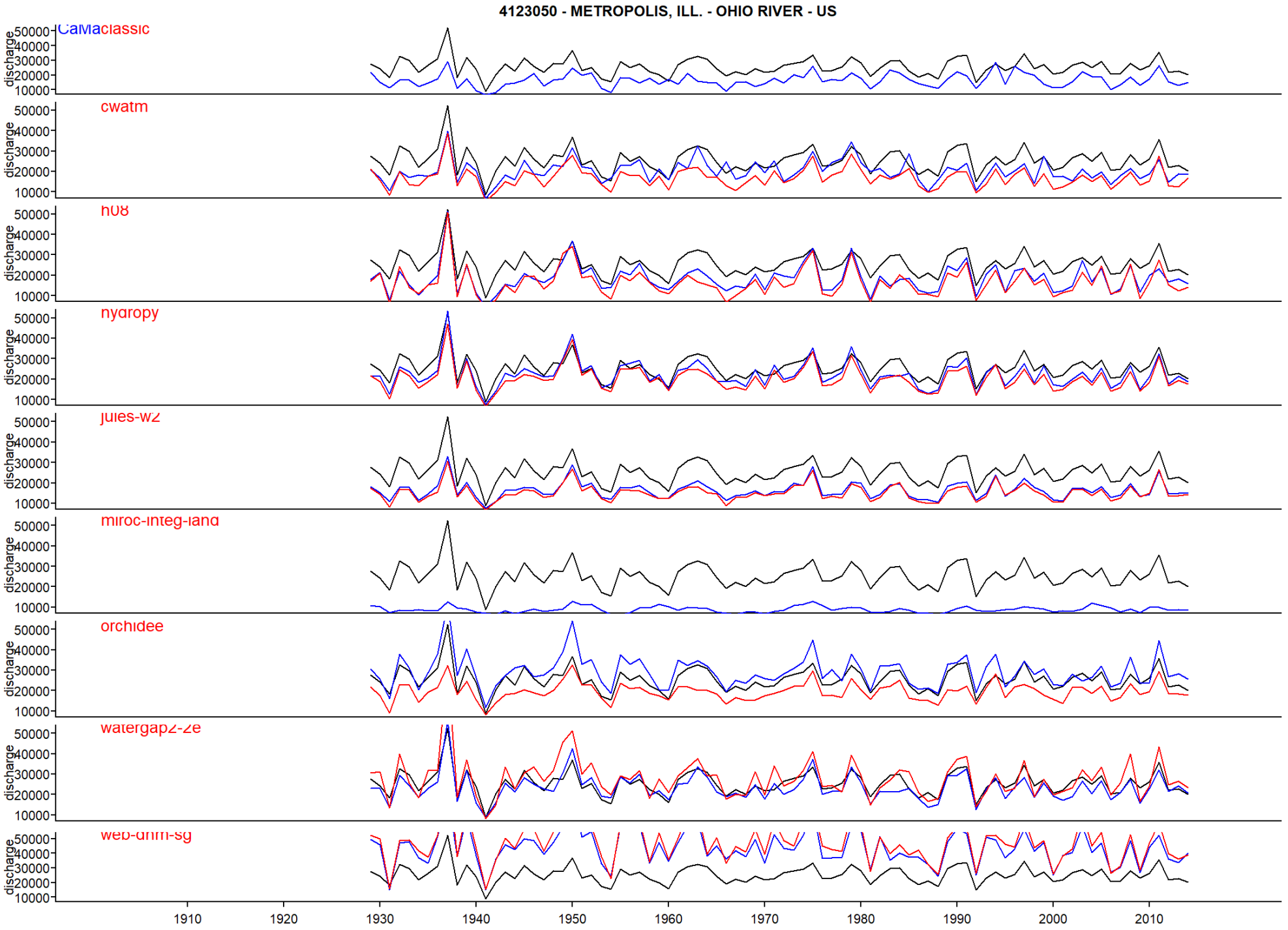
Result – maximum annual discharge

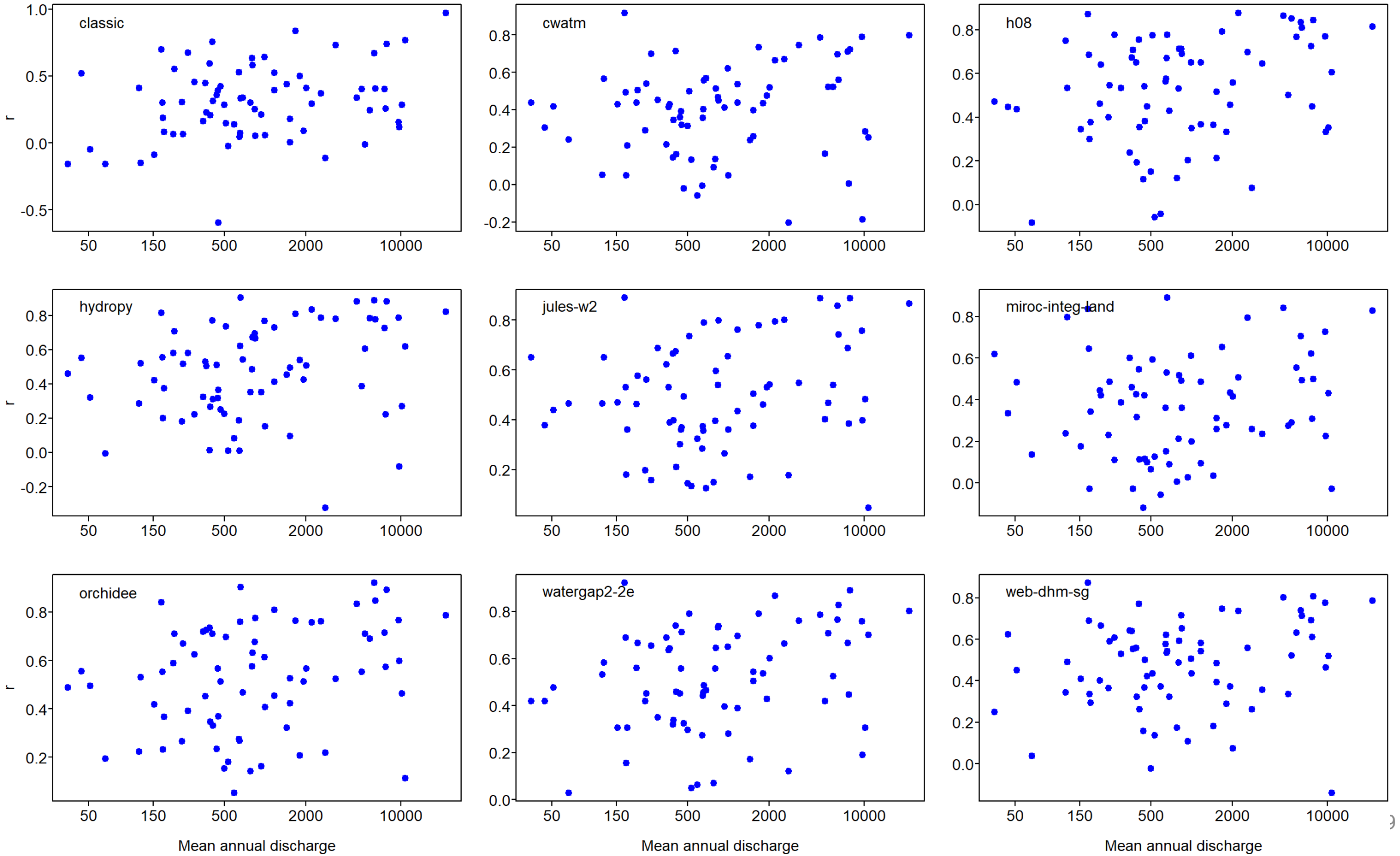
Result

observation

model routing

CaMa routing

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Mean annual discharge
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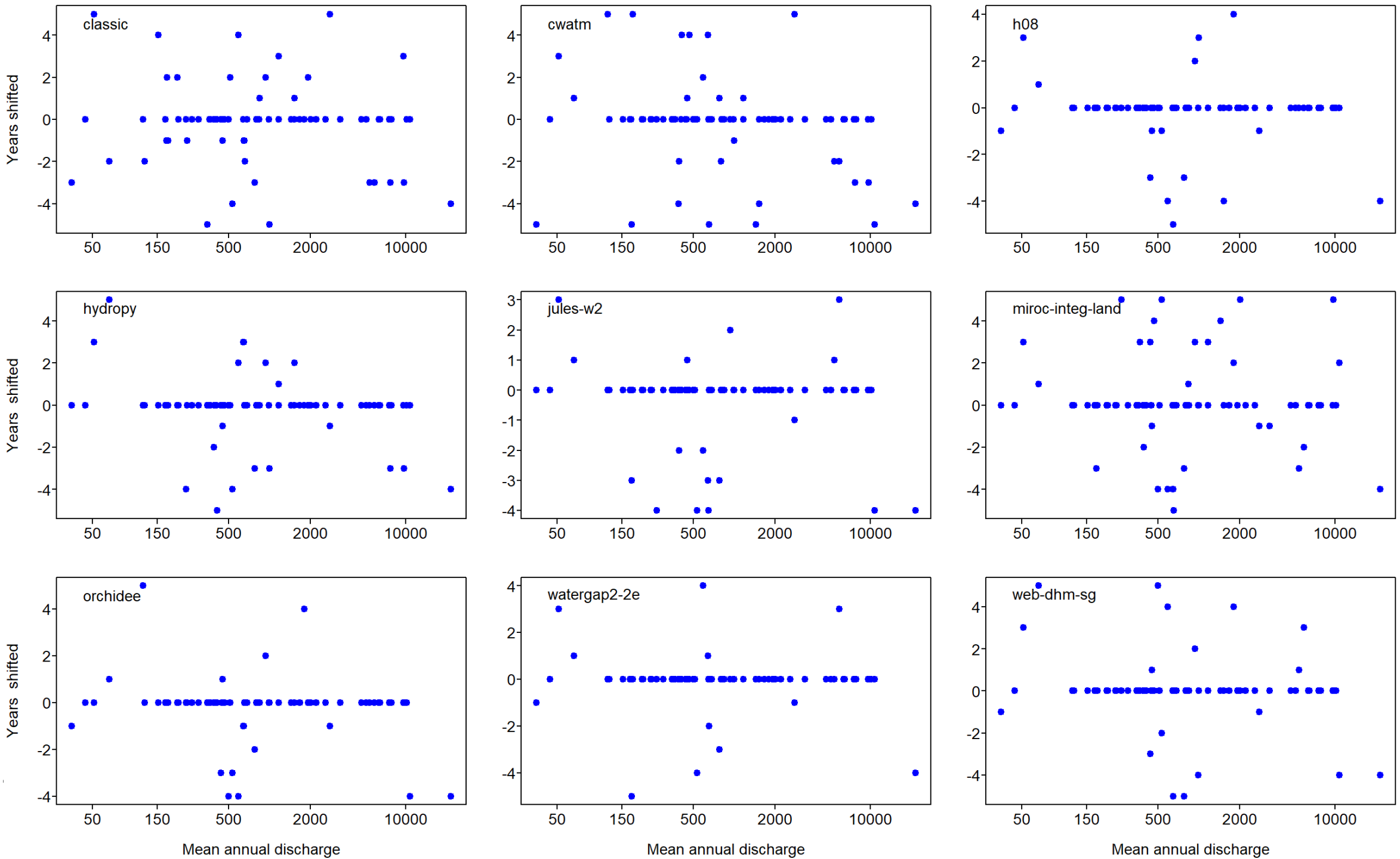
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hydropy
jules-w2
miroc-integ-land
orchidee
watergap2-2e
web-dhm-sg
Years shifted
Years shifted
Years shifted
Mean annual discharge
Mean annual discharge
Mean annual discharge
50
150
500
2000
10000

for one station

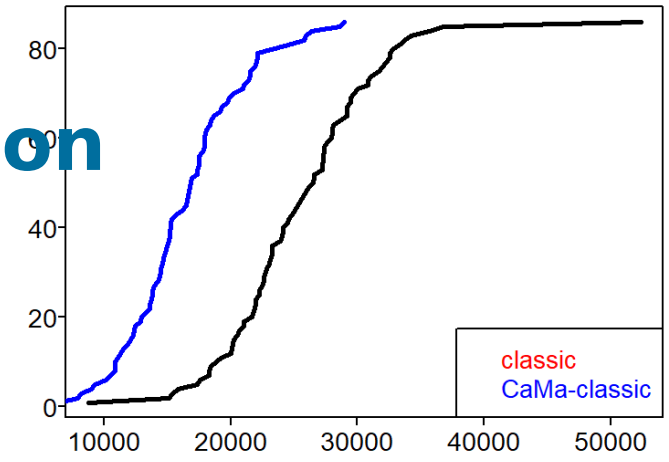
observation

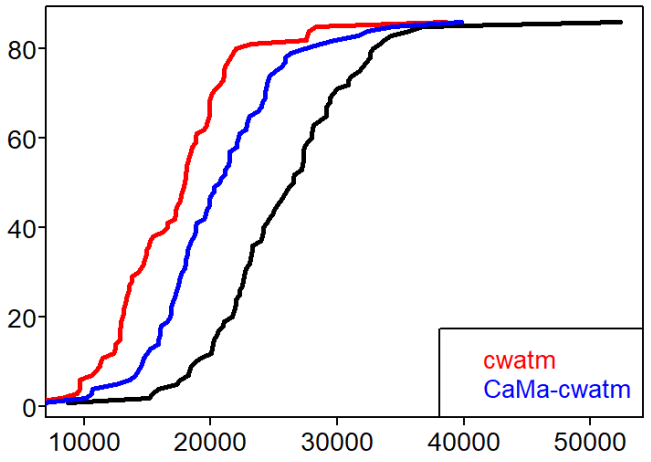
model routing

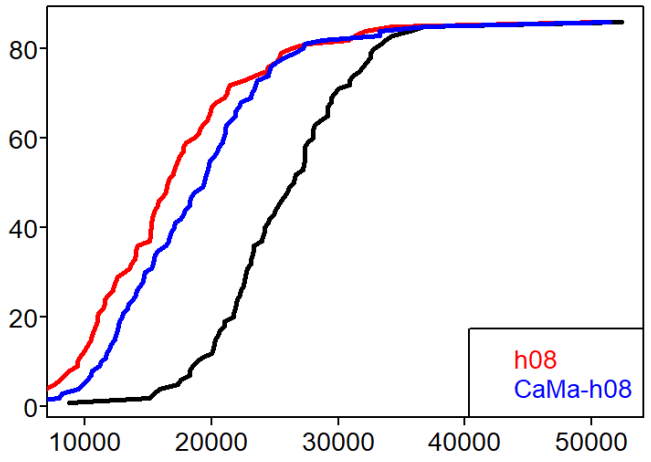
CaMa routing

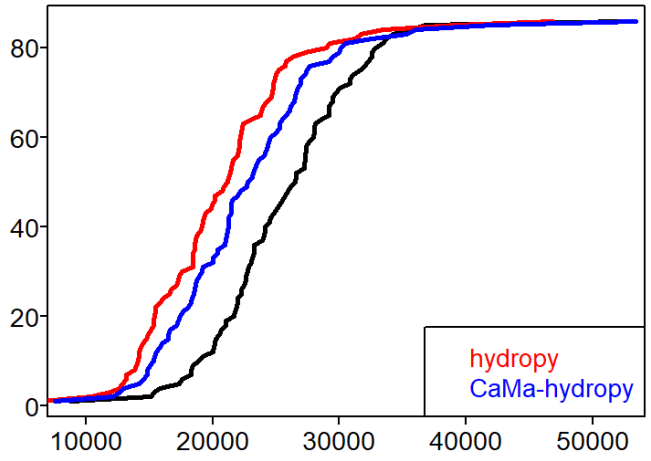
no. of years

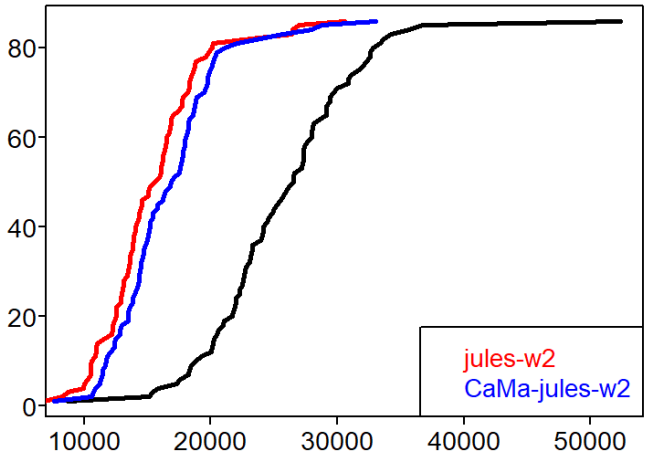
discharge

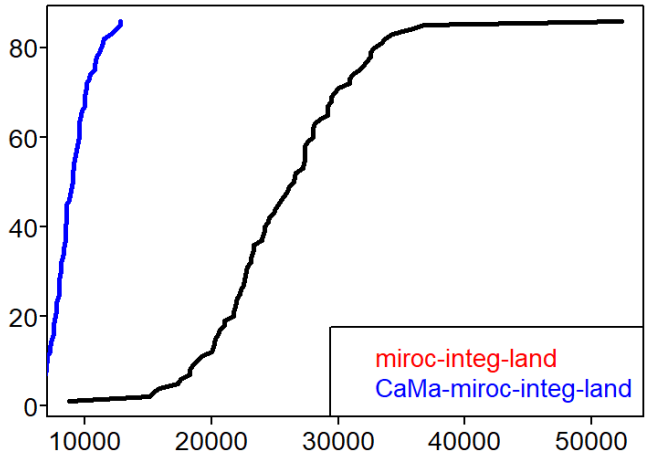


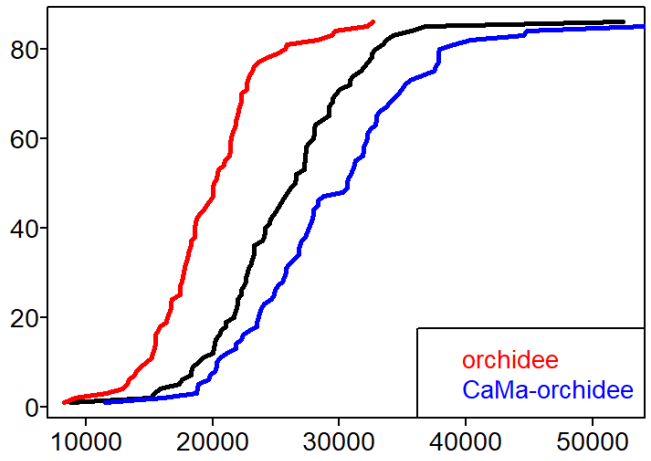


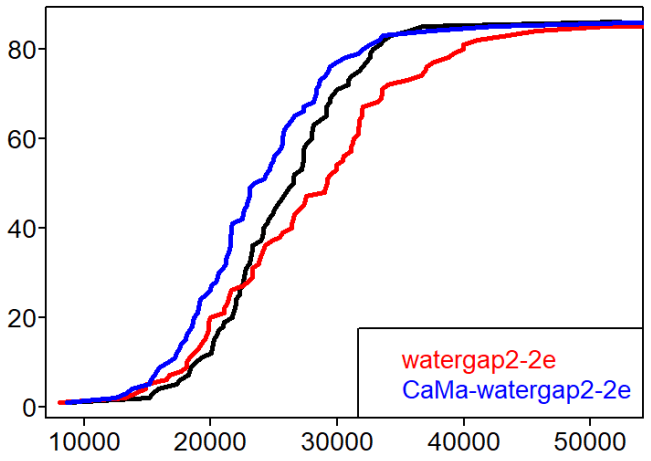


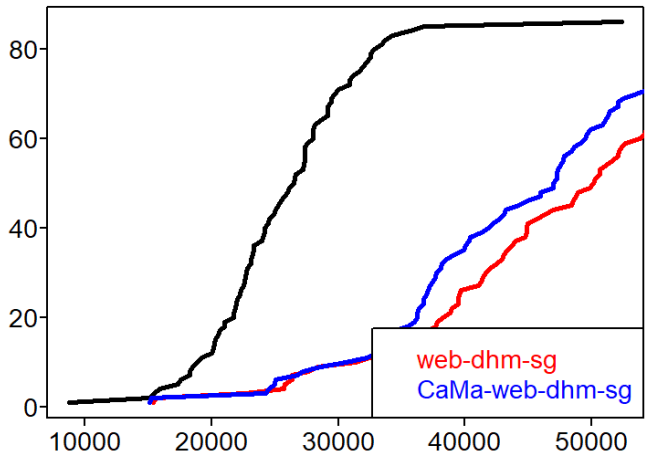












Next steps:

- **derive additional station parameters**
  - aridity index, elevation/slope, management
- **identify stations for which models are performing best + why?**
- **quantify the distribution of peak discharge**
- **investigate possibility for bias adjustment**

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