Laboratory of Water Resources Management and Coastal Engineering

JULES' VALIDATION AND FLUX PARTITIONING FOR LARGE-SCALE BASINS

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Introduction

Motivation:

- Simulation of the water cycle at the global, continental or basin scale
- Need for model validation → basin scale

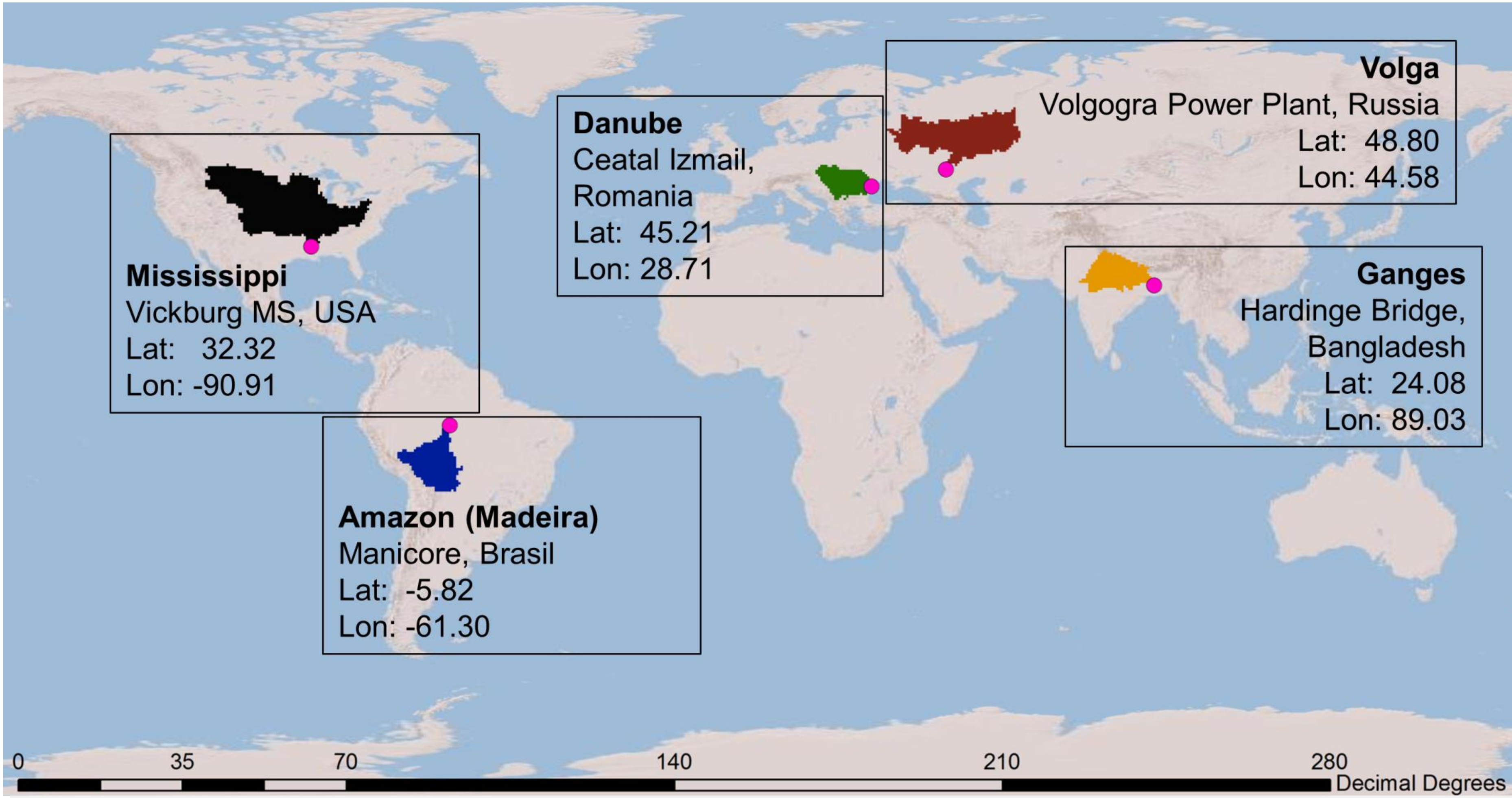
Scope:

- Evaluate model performance
- Identify model deficiencies comparing performance at different basins

Data & Simulations

- JULES version 3.4.1., default mode
- WFDEI forcing data
- $0.5^{o} \times 0.5^{o}$ grid resolution
- Global runs, Simulation period: 1979-2010
- Outputs: Precipitation, Surface & Subsurface runoff production, Evaporation from soil, Canopy evaporation

Basin extraction from world gridded output



- Watershed delineation using TRIP river routing scheme (flow direction template)
- Location of the gauging station is set as river pour point
- The cells into the boundaries of the watershed are extracted from the global output

Runoff routing

Model output: **surface and subsurface runoff production** per gridbox

✓ Required output for model validation: river **discharge**

✓ Conversion using a **conceptual lumped routing approach**

- × gridbox area
- Sum all gridboxes

Surface discharge production in the basin

Subsurface discharge production in the basin

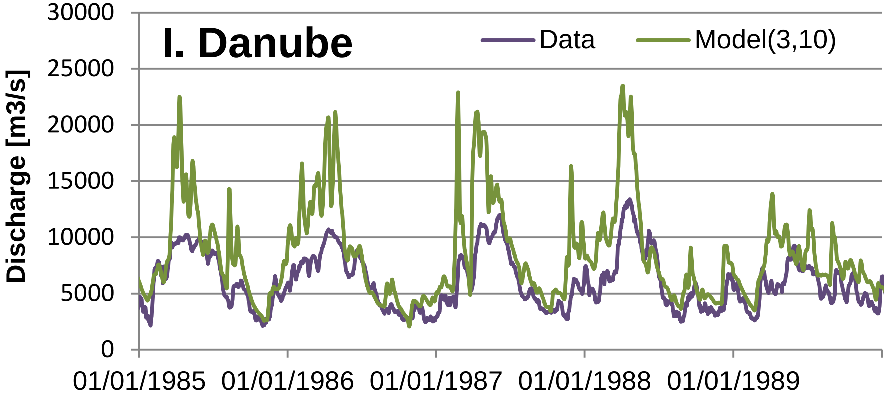
- Apply triangular filters
- Longer filter (slower response) for subsurface runoff
- 3 steps for surface runoff
- 10-50 steps for subsurface runoff

Delayed surface discharge

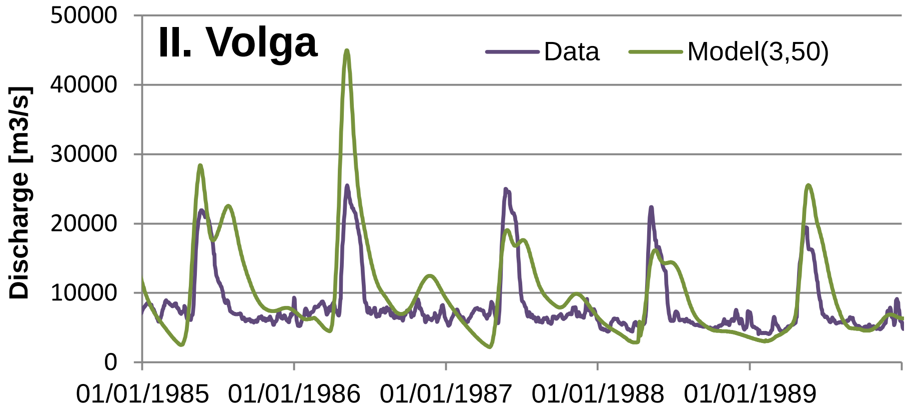
Delayed subsurface discharge

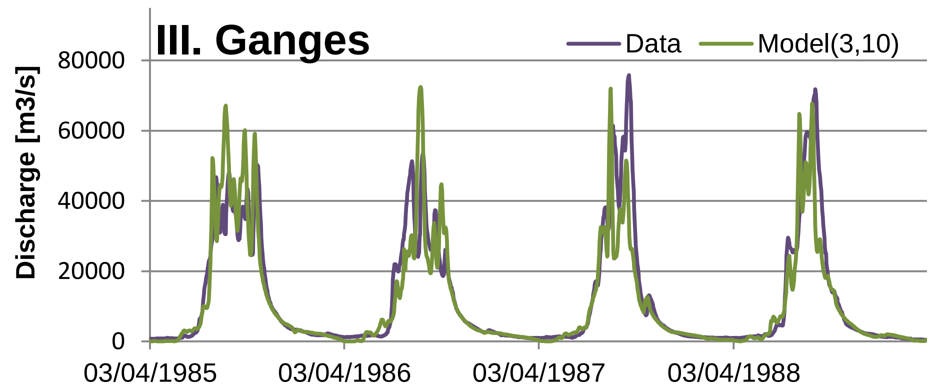
- Total response (discharge)
- Allows validation at daily time-scale

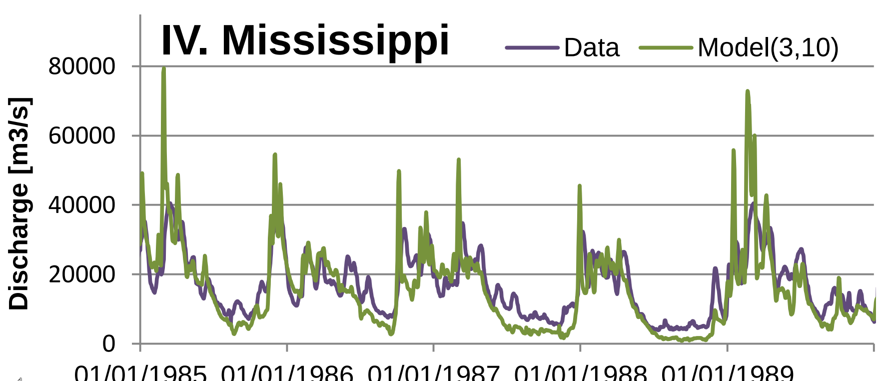
Evaluation (daily time-scale)

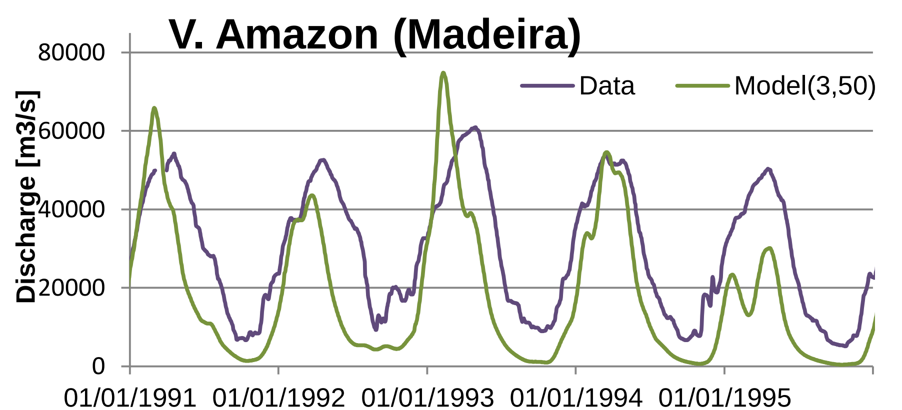


- The model shows more "peaky" response.
- Overestimates peaks and underestimates lower flows.







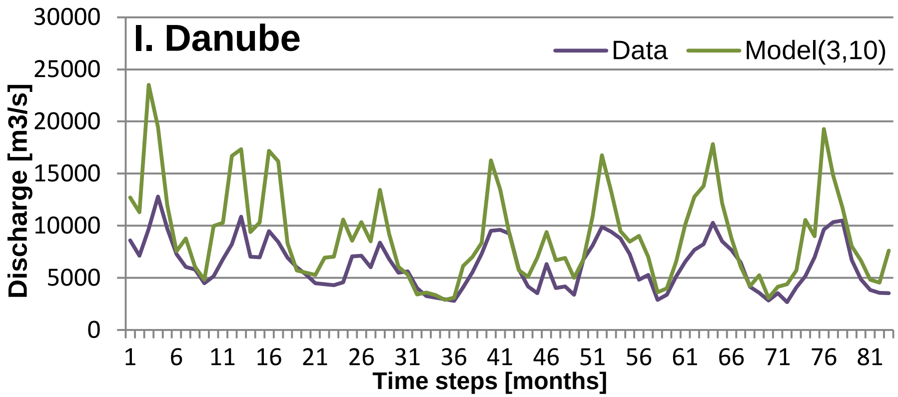


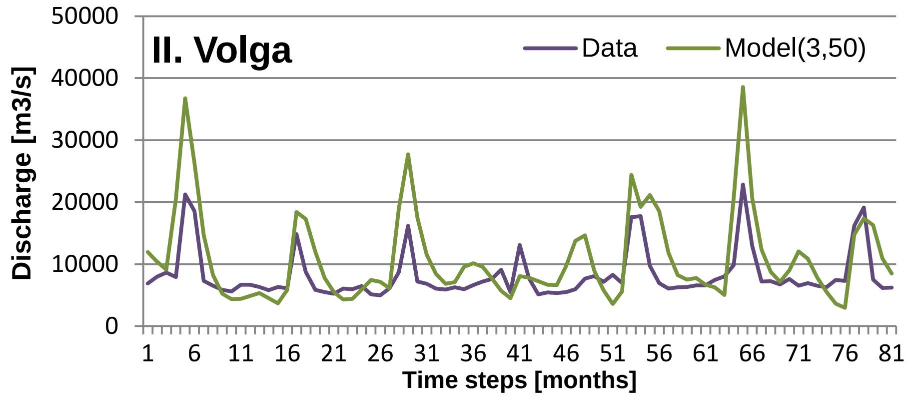
Evaluation (daily time-scale)

Daily	NSE	PBIAS(%)	R^2
I. Danube	-1.57	-38.44	0.566
II. Volga	-0.2	-20.25	0.61
III. Ganges	0.68	-4.04	0.75
IV. Mississippi	0.24	6	0.63
V. Amazon	0.06	18.76	0.57

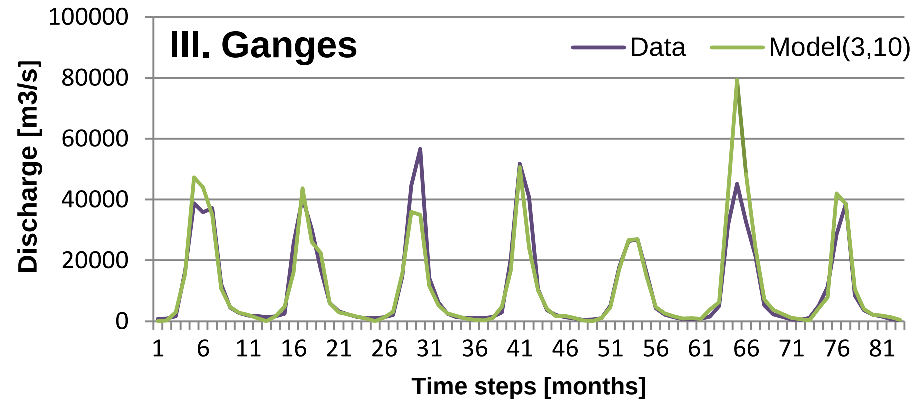
- Model performance varies between the basins.
- NSE and PBIAS vary significantly but all basins exhibit sufficient linear correlation.

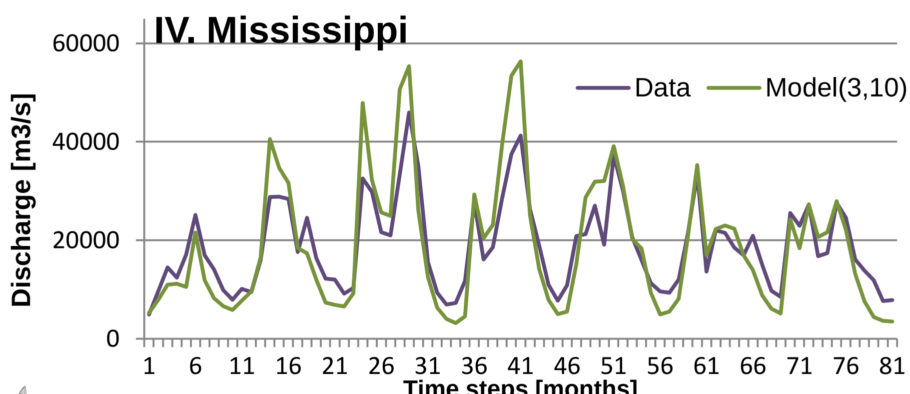
Evaluation (monthly time-scale)

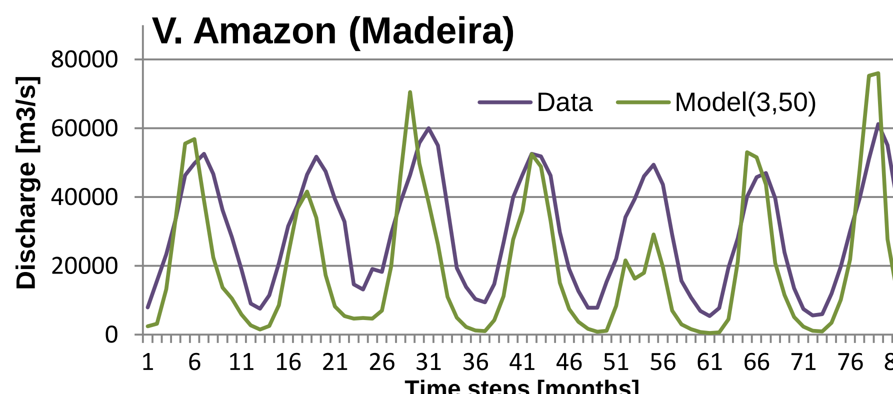




- Model behaviour is clearer at the monthly time-scale.
- High flows are overestimated in most basins. Time of peaking is correct but the simulated discharge values are much higher.





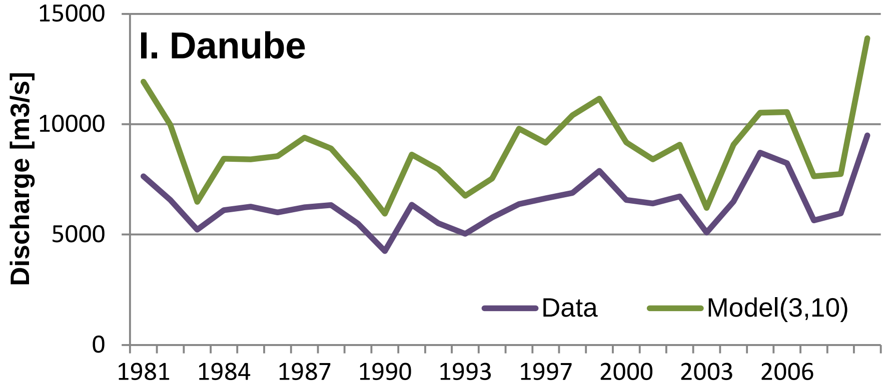


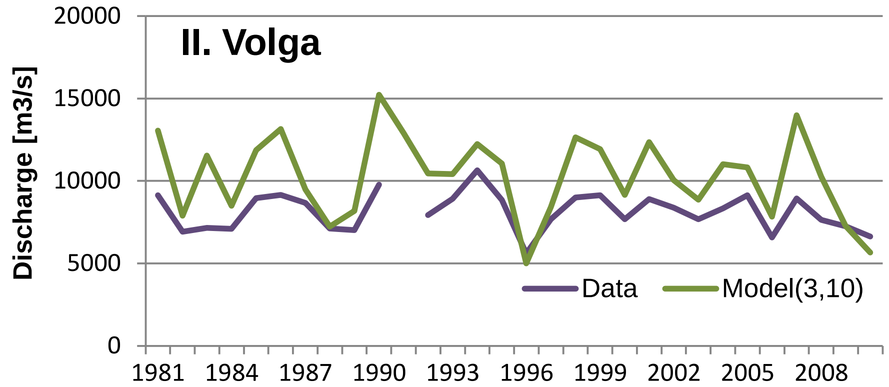
Evaluation (monthly time-scale)

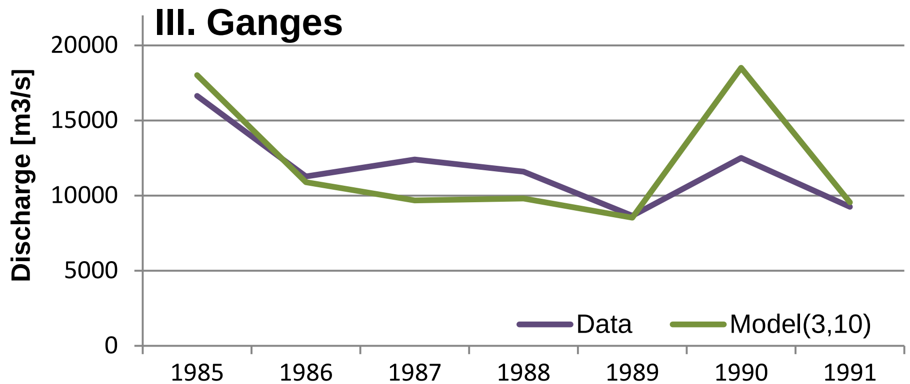
Monthly	NSE	R^2
I. Danube	-1.18	0.71
II. Volga	-0.28	0.67
III. Ganges	0.87	0.86
IV. Mississippi	0.57	0.81
V. Amazon	0.07	0.59

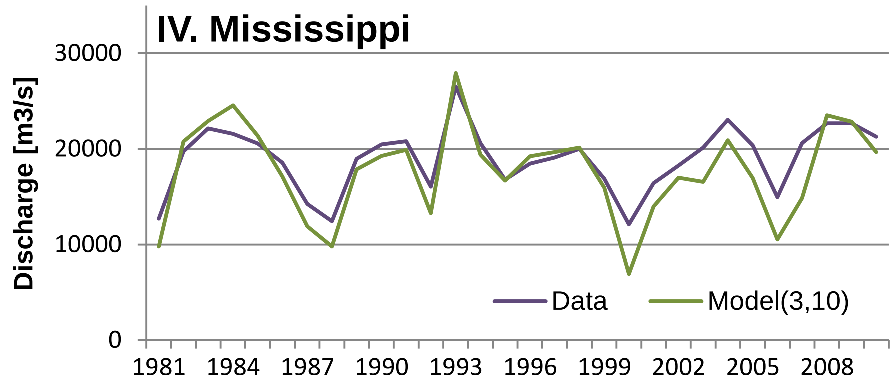
Model performance is better when evaluated at the monthly time-scale.

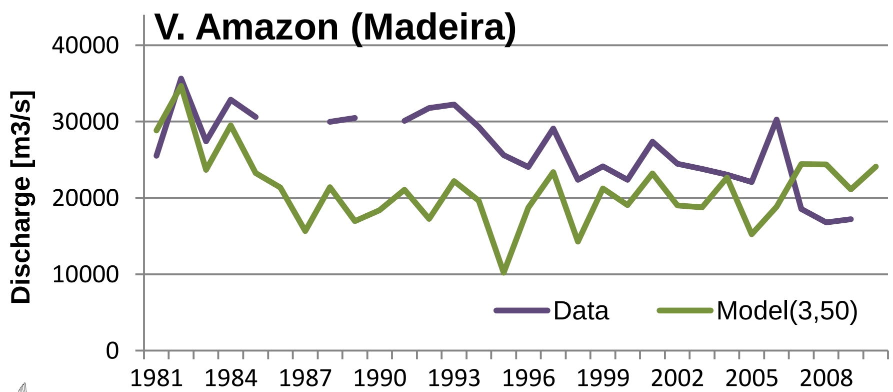
Evaluation (annual time-scale)











Annually	R^2
I. Danube	0.87
II. Volga	0.73
III. Ganges	0.58
IV. Mississippi	0.88
V. Amazon	0.08

Comparing performance at different time-scales

Daily	NSE	PBIAS(%)	R^2
I. Danube	-1.57	-38.44	0.566
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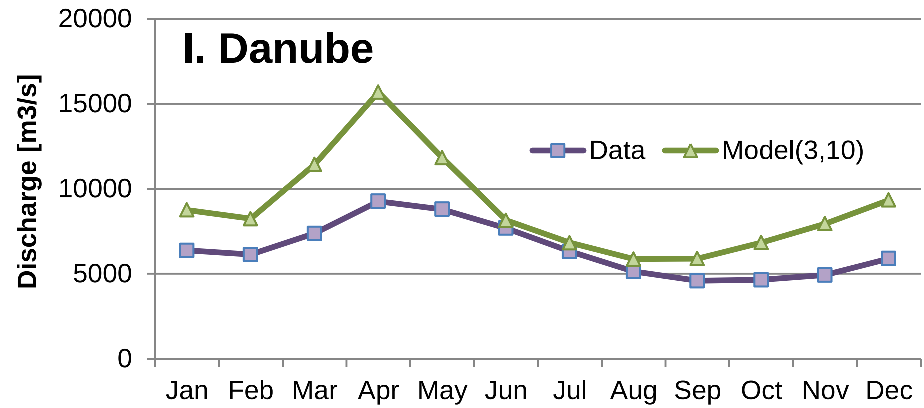
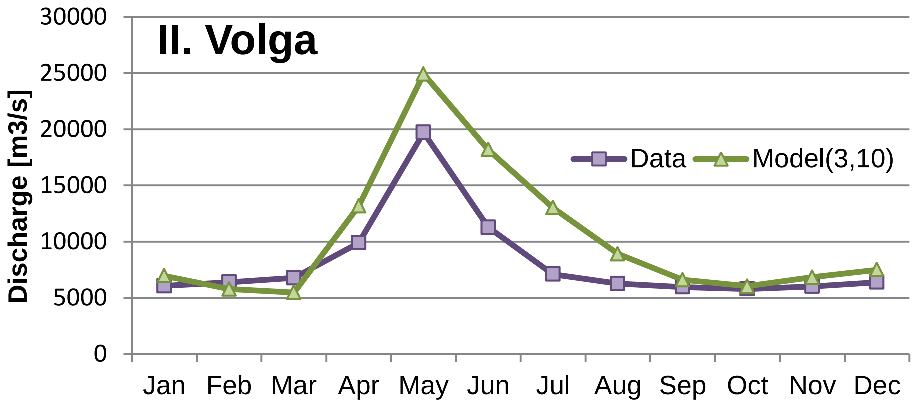
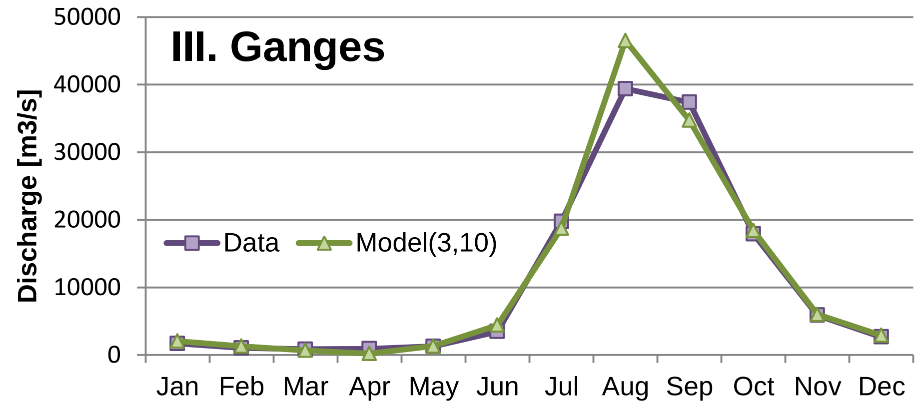
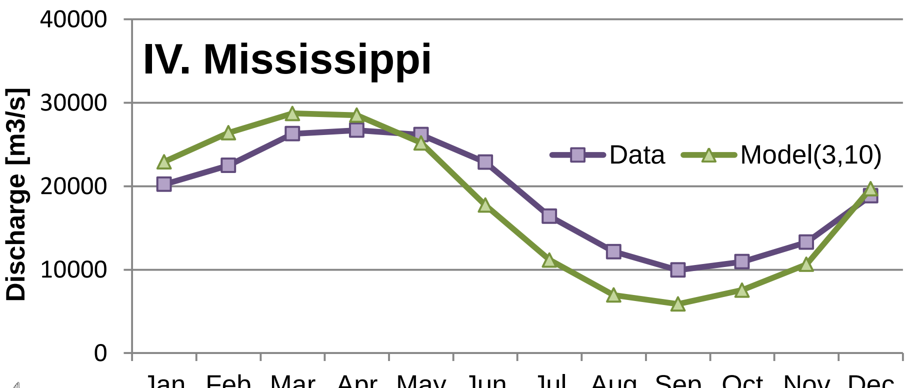
Discharge Seasonality

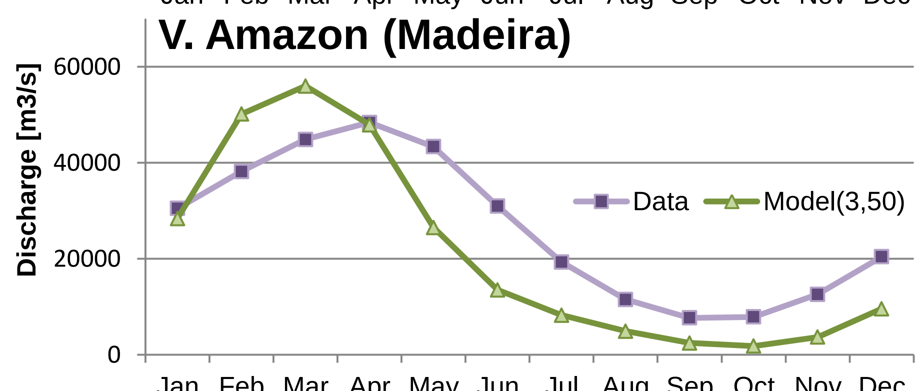
- Averages per month for all years
- Model deficiencies can be identified
- Differences in the performance between the basins and throughout the year





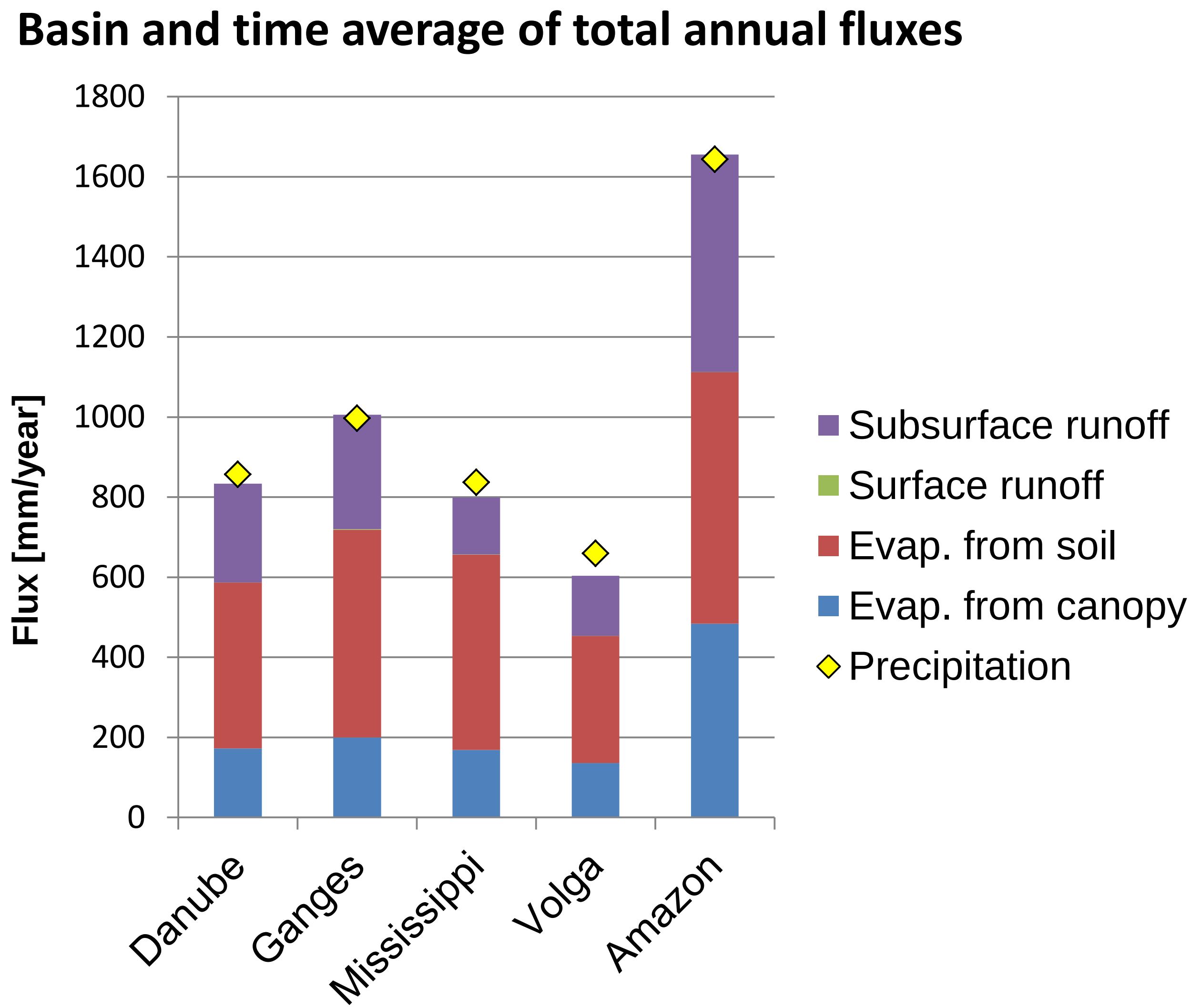




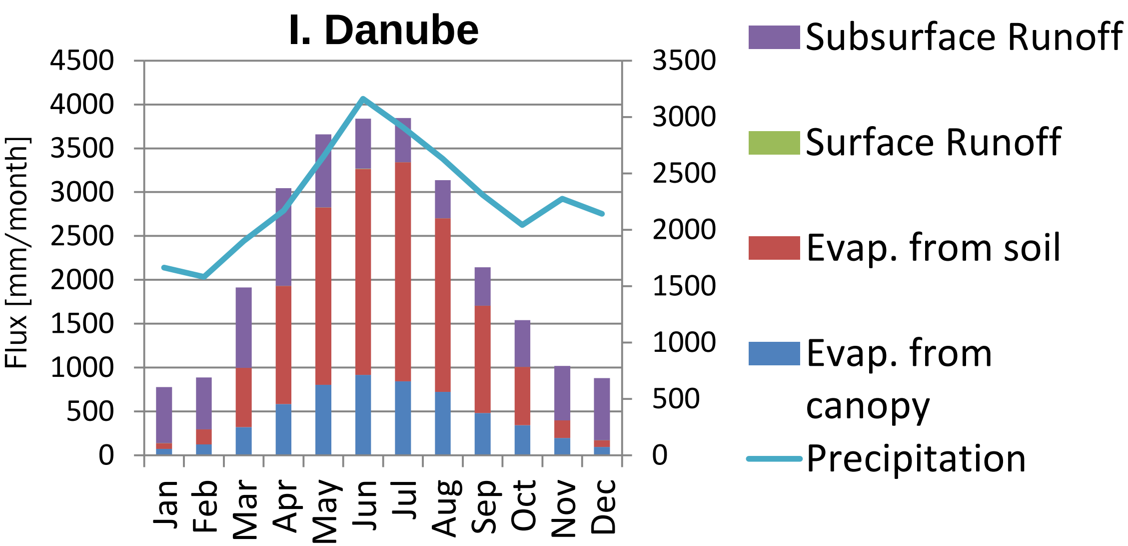


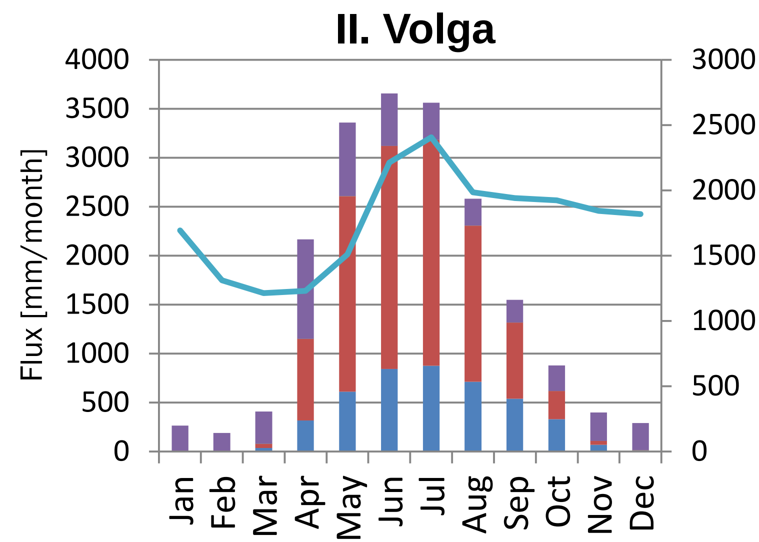
Partitioning water cycle fluxes

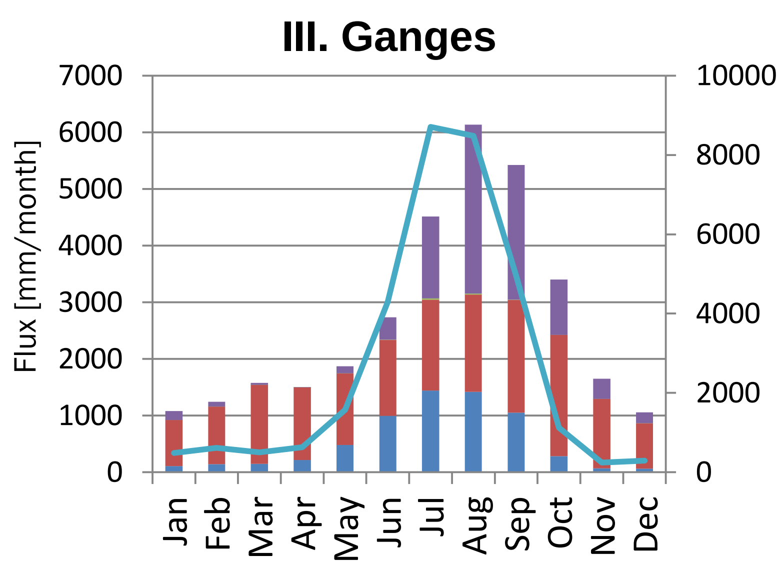
- Partitions seem to follow the same pattern in all basins.
- Surface runoff production is very small compared to the other fluxes. Discharge is practically governed only by subsurface runoff production.



Seasonal flux partitioning



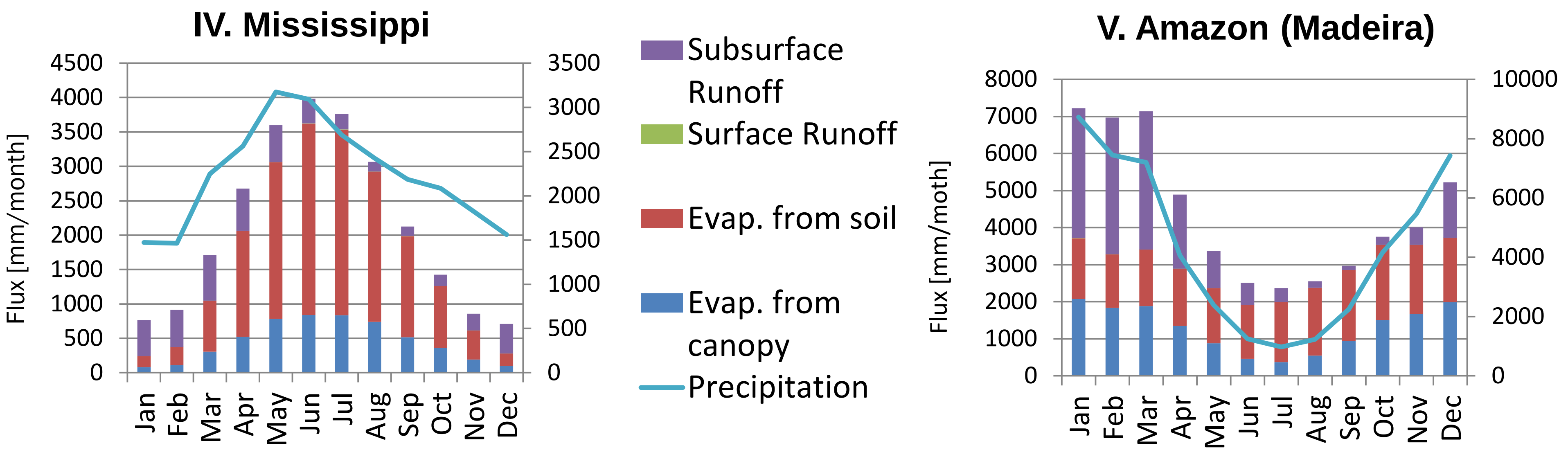




For **Danube** and **Volga** evaporation from soil and from canopy (ET) are the largest components during the wet seasons.

Ganges exhibits higher subsurface runoff during the wet season compared to the dry season.

Seasonal flux partitioning



For **Mississippi** the governing partition is evaporation from soil, especially during the wet season. The subsurface runoff component is small all year round.

Amazon exhibits the smallest soil evaporation partition and the largest subsurface runoff partition compared to the other basins, especially for the wet months.

Concluding remarks

- For the same run, model performance varies between different basins.
- Simulations are more robust at larger time-scales.
- Surface runoff production (in the default model version) is a very small part of the water balance, almost negligible for discharge calculation.

...and some questions to be answered

- Can we calibrate? Which parameters can improve model performance in terms of the simulation of the water cycle components? Which parameters would affect flux partitioning?
- Is it possible to calibrate at the global scale?

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Thank you!
Any questions?

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