Can an ensemble of downscaled global hydrological model outputs improve the performance..

~~..and spatially disaggregate the output~~ of a catchment scale model..

..in data scarce contexts?

HS4.4 Ensemble and probabilistic hydro-meteorological forecasts: predictive uncertainty, verification and decision making

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Hydrological modelling is hard

Hydrological modelling requires many specialized skills to overcome problems:

- obtaining and preprocessing data, navigating hydrological jargon, model selection, model calibration, model validation etc..

If we don’t have these skills, we can

- obtain them with a lot of time and effort,
- hire a professional, with some money, or
- ***use existing models or their outputs!***

Using existing models?

Global model results are freely and openly available

- ISIMIP, AQUAMIP, directly from authors, etc..

However, global models often have too coarse resolution and/or poor performance in local contexts. Sometimes a local model has already been set up, but are calibrated for a different purpose.

Solution: Use a combination of downscaled global models, and available local models?

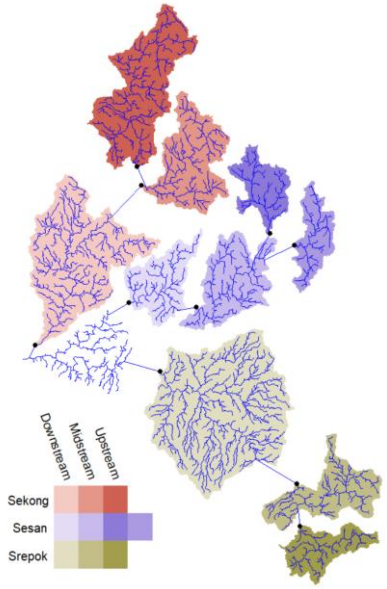
In this study

Can an ensemble of downscaled global hydrological model outputs improve the performance?

1. Downscale 16 daily runoff products from the ISIMIP 2a (Water Global), and apply routing to estimate streamflow
2. Apply model averaging using the downscaled timeseries' and local model predictions against observed streamflow

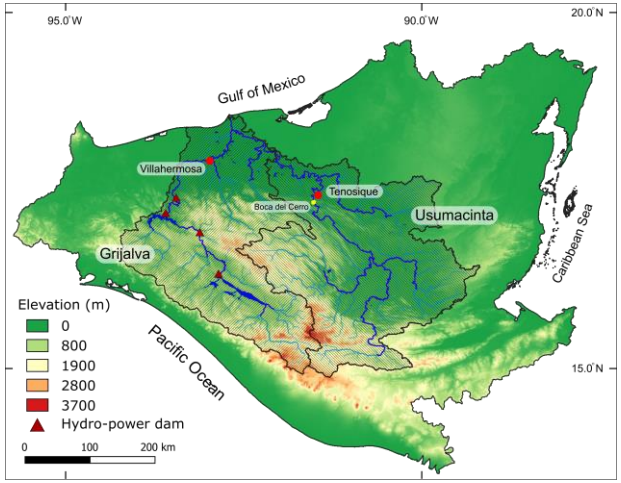
Sekong, Sesan, Srepok (3S) Basin (Southeast Asia)

10 monitoring stations, calibrated against one of them



Boca del Cerro (Mexico)

1 monitoring station



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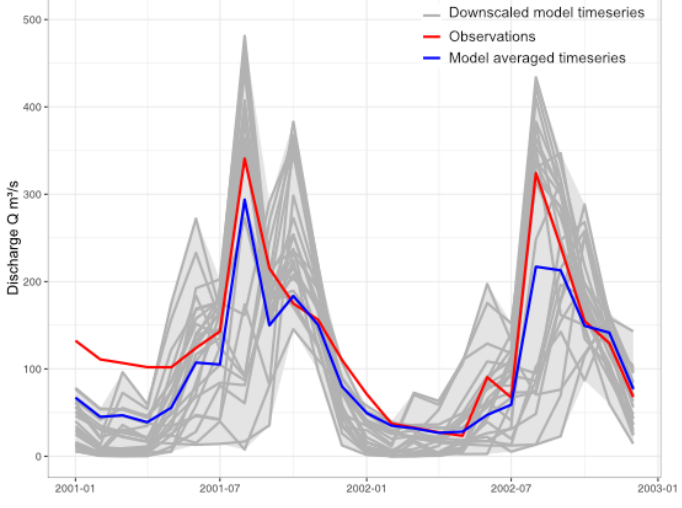
Downscaling and model averaging

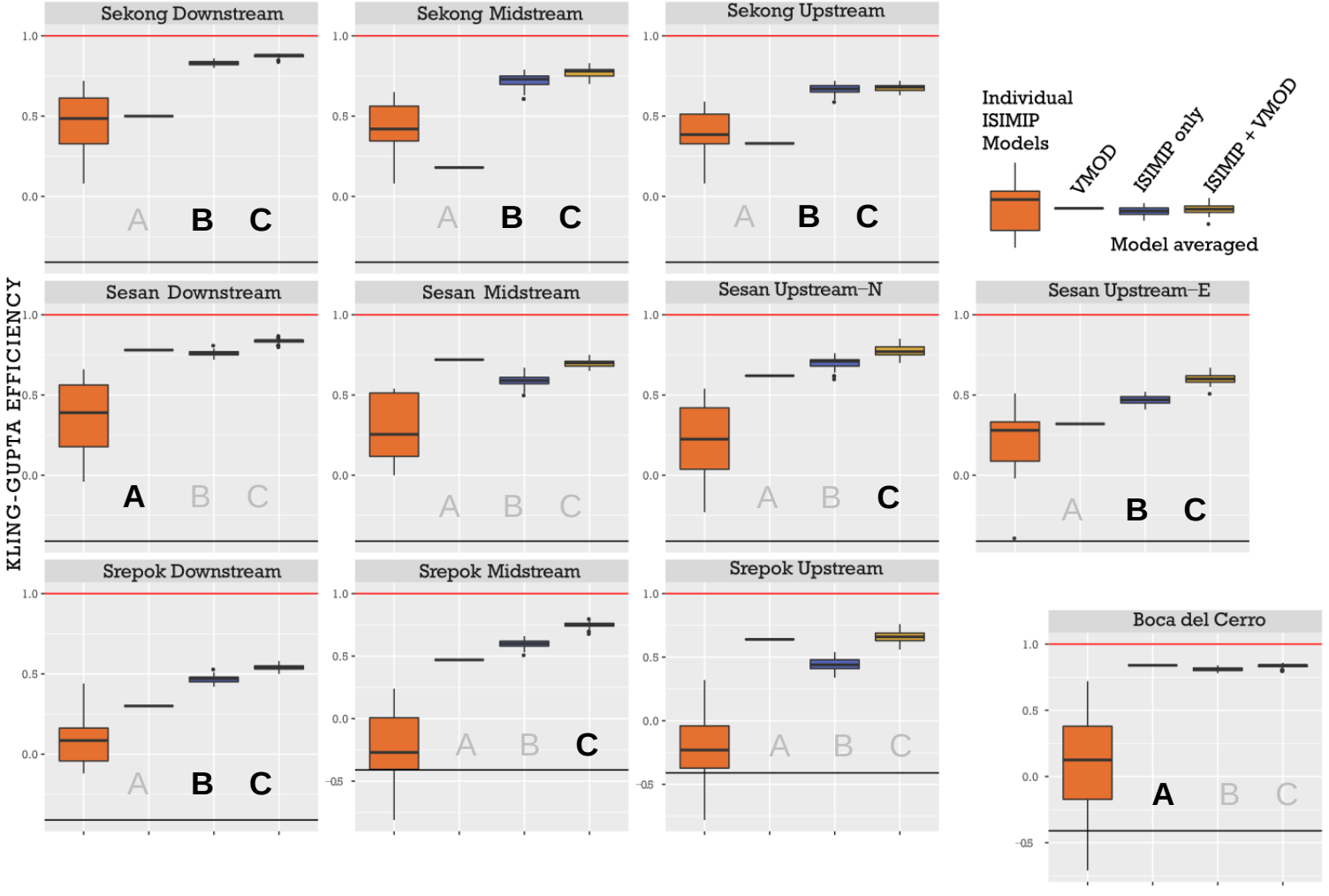
1. **0.5 degree runoff grid downscaled** to HydroSHEDS 15 arc-second river network using areal interpolation.
2. Discharge estimated with a **constant velocity routing** algorithm using 1 m/s flow velocity.
3. Timeseries in each monitoring station were combined using **Non-Negative Least Squares** (no negative coefficients allowed) using random timesteps (50%) of the available observation timeseries.

We did model averaging using

- ISIMIP runoff products (16 members)
- The ISIMIP ensemble added with the output of catchment scale VMOD instance (17-members)



Can an ensemble of downscaled global models improve the performance of local models?

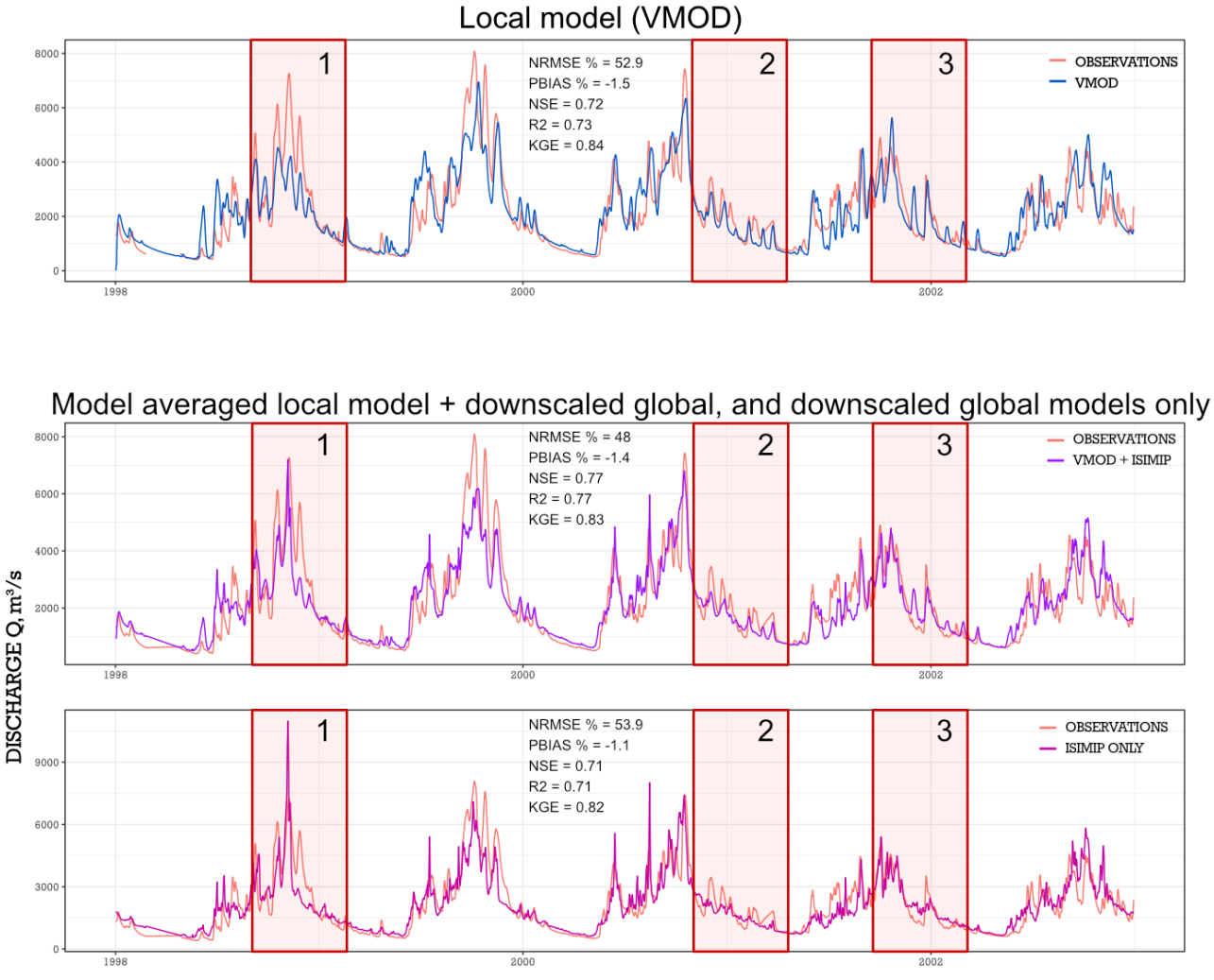


A. VMOD is calibrated at this station, and performs best

B. Some of the downscaled global models perform better than local model

C. Model averaged global models perform better than local model

Snapshot from Boca del Cerro model averaged timeseries’



1. VMOD underestimates the flood peaks while ISIMIP models overestimate. Model averaging with VMOD+ISIMIP ensemble produces best result.

2. VMOD can capture the increased flow events, while model averaged ISIMIP optimum cannot.

3. Model averaged ISIMIP optimum works better at wet season peaks, but fail to capture the second peak.

Can an ensemble of downscaled global models improve the performance of local models?

The verdict is: “it depends”.

- Numerically there is a small improvement in stations which the local model is calibrated against.
- Visual comparison of the timeseries show a small improvement, capturing “the best of both worlds”
- For stations which use regionalized parameters in the local model, an ensemble with local models can give a significant improvement

Model averaging an ensemble of global hydrological models can deliver reasonably accurate estimates by themselves, without information from a local model.

Can an ensemble of downscaled global models spatially disaggregate the output of a catchment scale model?

Work in progress.

Thank you!

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