

Global estimation of rainfall-runoff model parameters: an empirical experiment

Santos L.^{1,2}, Andersson J.C.M.¹, Arheimer B.¹

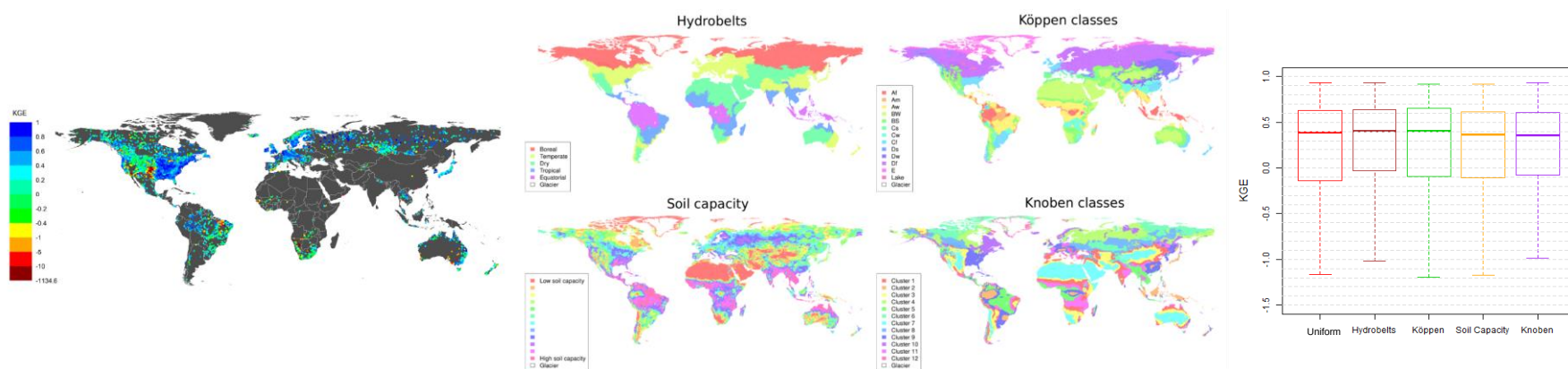
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1. Aim:
Improve performances of a
global hydrological model

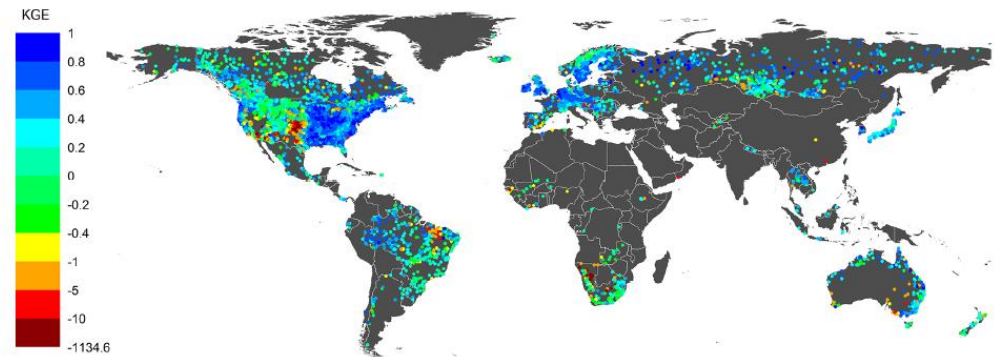
2. Method:
Four regionalisation of soil-
runoff parameters

3. Results:
Slight improvement in terms of
spatial and temporal
robustness

Introduction

Base material: World-Wide HYPE (WWH, Arheimer et al., 2020)

- Global model based on the process based model HYPE
- Median KGE performance of 0.4025
- Can we do better?
- “Devil is in the details” (see Arheimer B., EGU21-12778): let's look into some details and find out if he is there.
- Here the detail is the soil-runoff parameter calibration
- How to regionalise these parameters at a global scale to optimise its performances?



KGE Statistics

Median : 0.4025

Max : 0.929

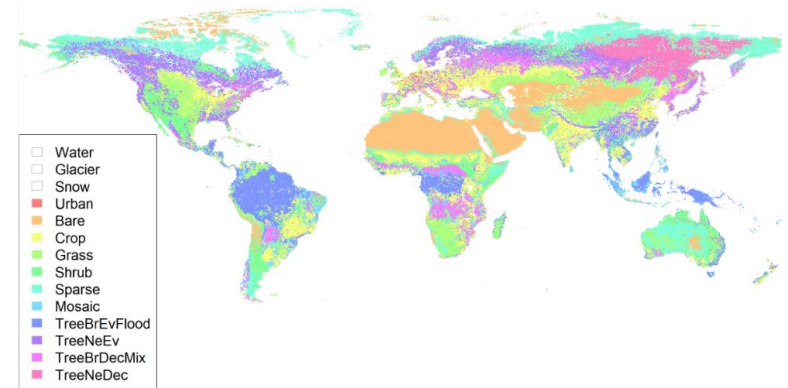
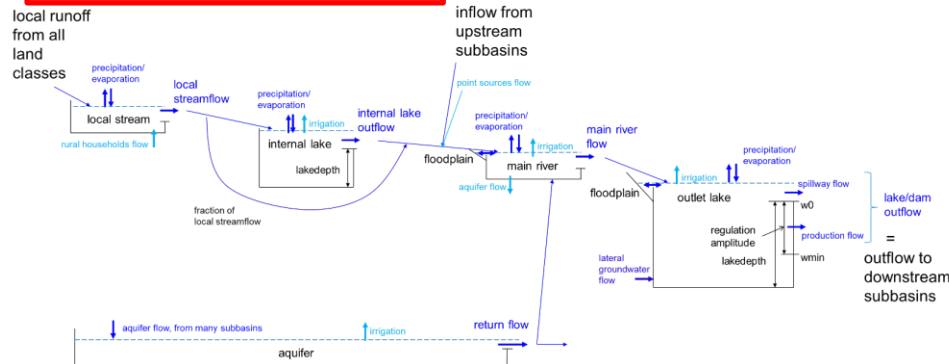
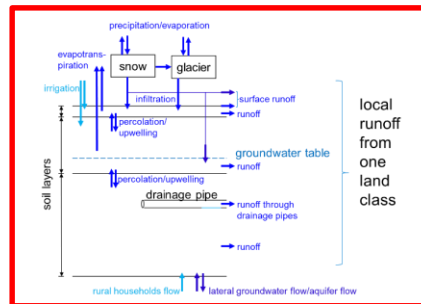
Q75 : 0.638

Q25 : 0.027

Min : -1.1e+03

Soil-runoff processes in WWH

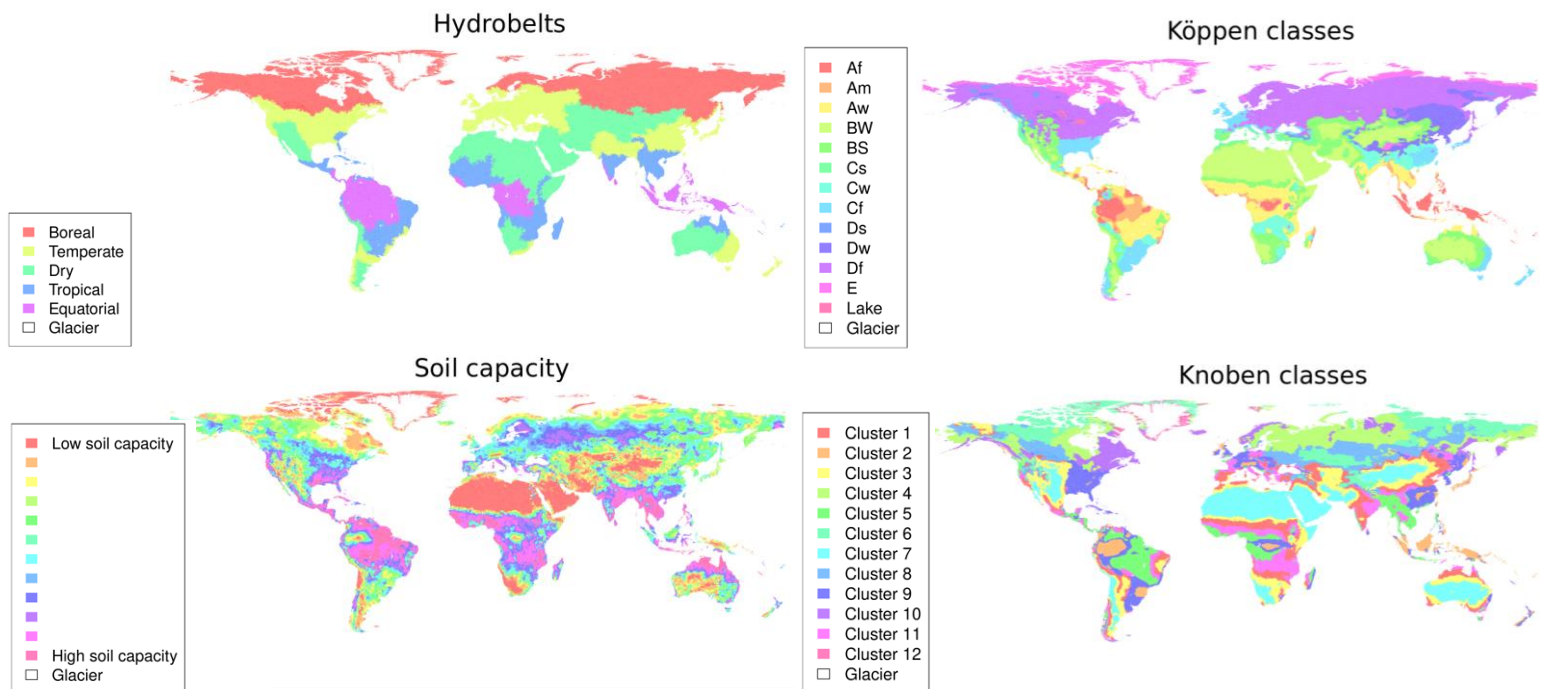
- 17 calibrated parameters (8 for soil and 9 for snow)
 - Spatialized by land classes
- Here 14 land use classes and one uniform average soil



Four tested regionalisation methods

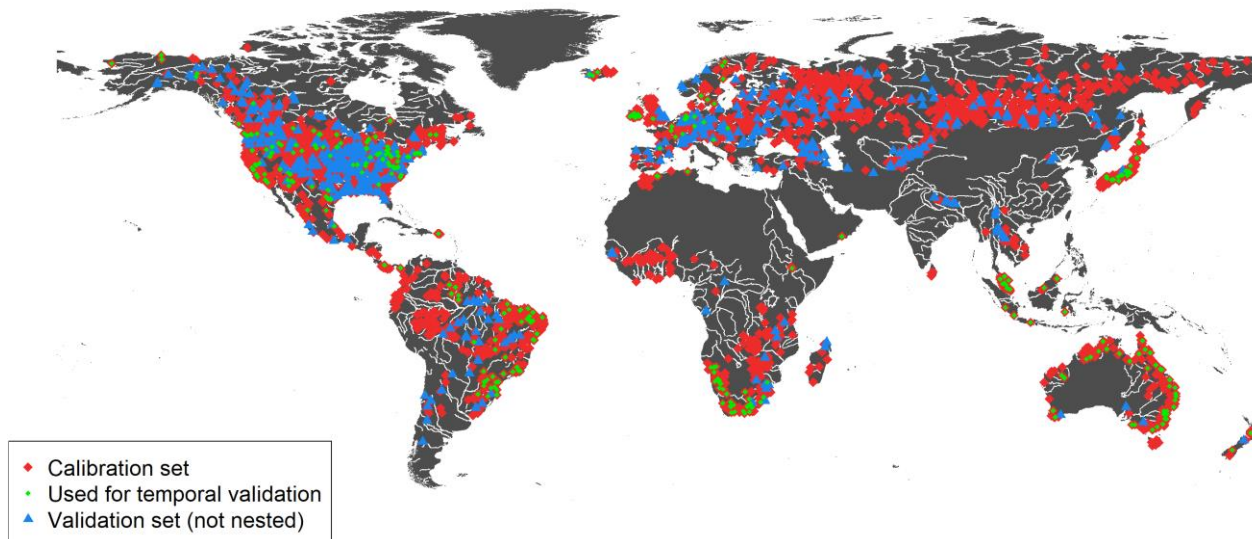
Use of classifications based on climatic or hydrological indicators:

- Hydrobelts (Meybeck et al., 2013)
- Köppen classes (Kottek et al., 2006)
- Soil capacity (Wang-Erlandsson et al., 2016)
- Hydro Climatic classes (Knoben et al., 2018)



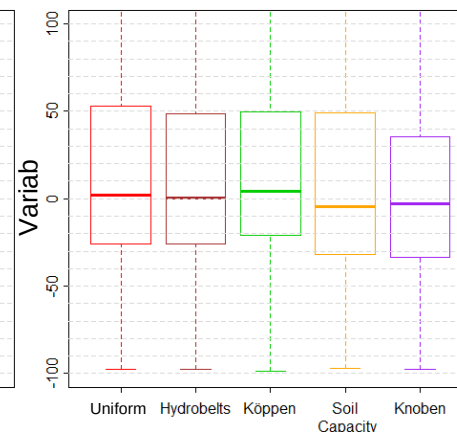
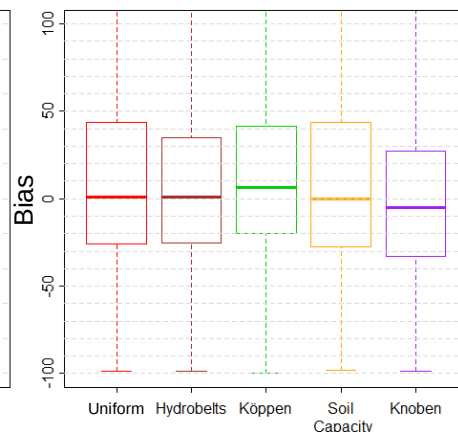
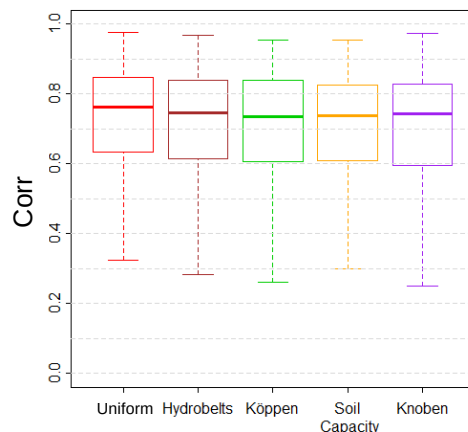
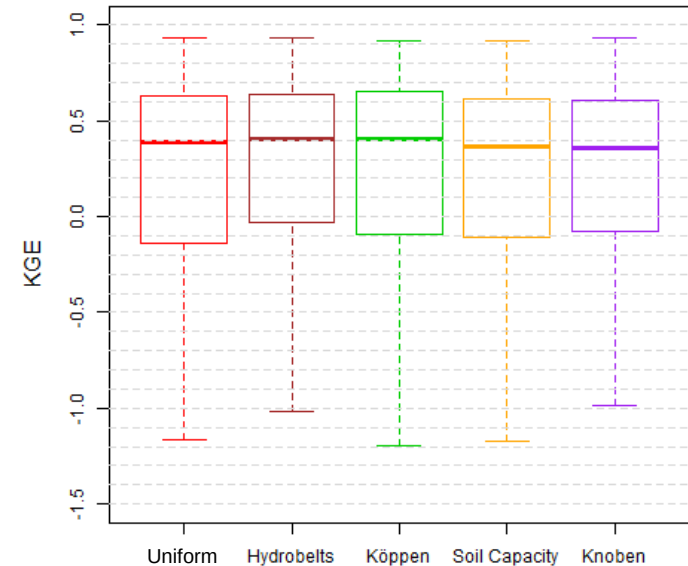
Methodology and catchment sets

- Calibration is done in parallel for each class on gauged catchments dominated by a given class
- Temporal and spatial validation
- Data Set: 2905 gauged stations used for calibration, 516 for spatial validation and 320 for temporal validation



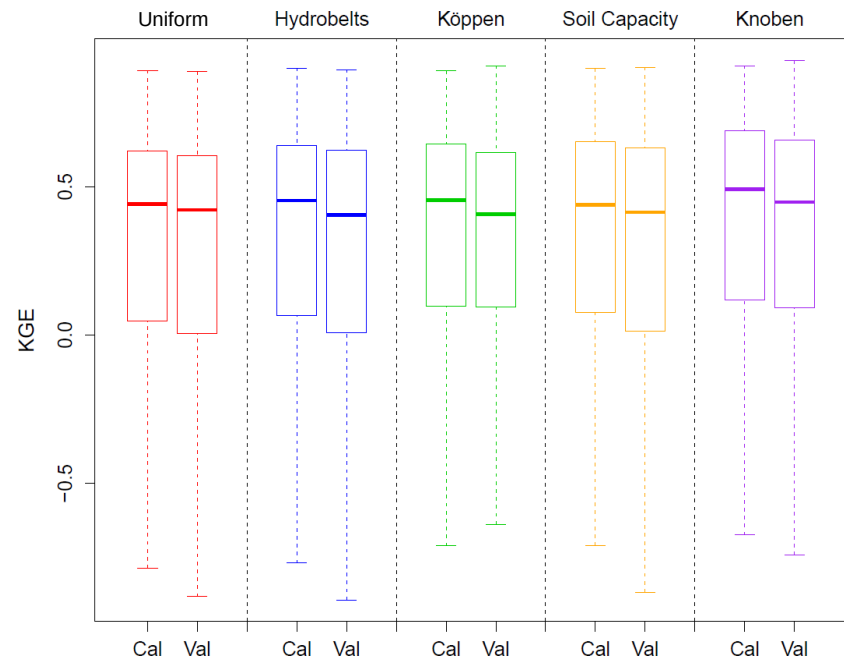
Spatial validation

- Median KGE around 0.4 for all experiments
- Hydrobelts and Köppen have slightly better values
- Hydrobelts have more balanced values regarding KGE components



Temporal validation

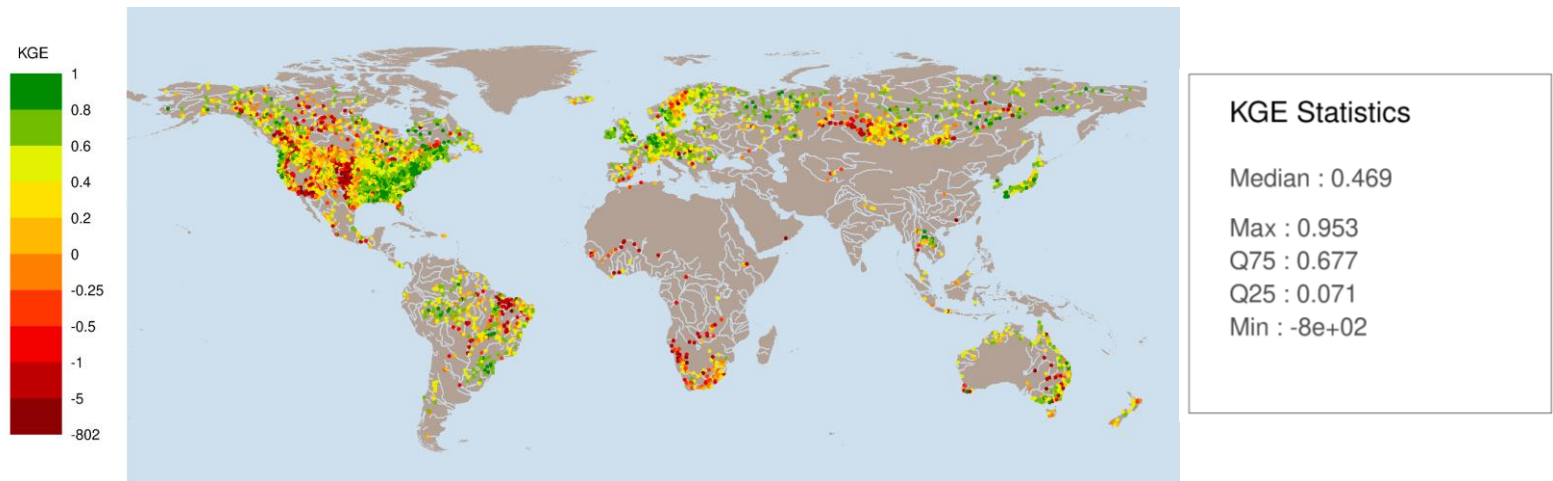
- Loss of performance in evaluation period is similar for every experiment
- Köppen and Knoben experiments are more robust



Statistics on $KGE_{cal} - KGE_{val}$	Uniform	Hydrobelts	Köppen	Soil capacity	Knoben
Mean	0.078	0.050	0.042	0.069	0.052
Median	0	0.001	0	0.001	0
Standard deviation	1.12	0.64	0.26	0.52	0.23

Comparison to baseline WWH

- Performance comparison to baseline WWH on the same catchment set and for the same period
- (Low) median improvement of 0.065



Performances for Knoben experiment

Conclusion

- Low advance obtained from regionalisation
- Very similar performances between each regionalisation methods

Is the devil hidden in soil-runoff calibration?

→ Just a little bit

This work proposes one possibility to improve World-Wide HYPE but should be combined with other efforts

This work is part of a scientific article soon to be submitted

What else can be improved?

- More detailed Land Use map
- Improvement of precipitation: (ERA-5 instead of ERA-Interim)
- Improvement of water routing in river
- Improvement of evapotranspiration calculation

More details at HS2.5.2 session on Monday 26 April 2021 at 09:15

References

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