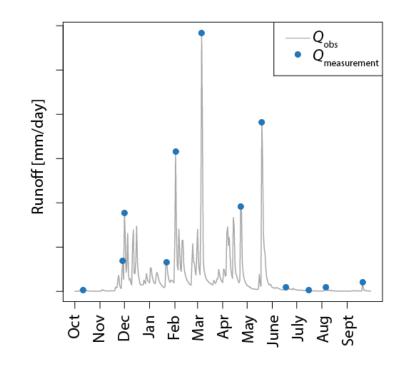




Which runoff measurements are most informative for constraining a bucket-type hydrological model?

Sandra Pool Daniel Viviroli Jan Seibert

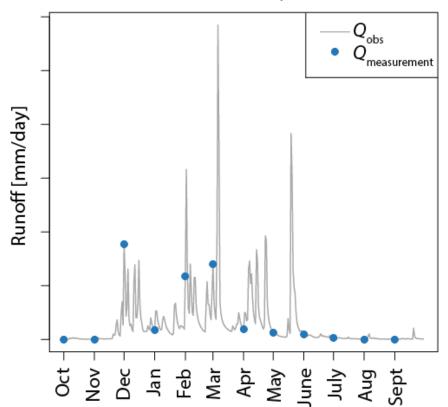
Contact: sandra.pool@geo.uzh.ch



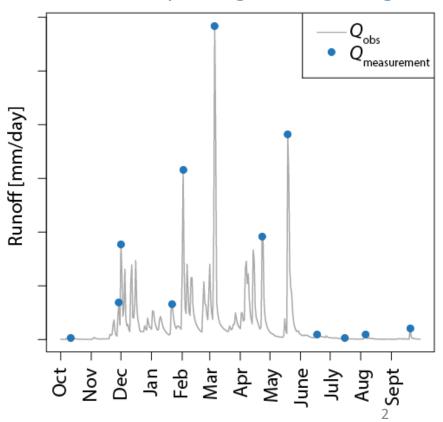
Prediction in almost ungauged catchments:

... when would you measure runoff?

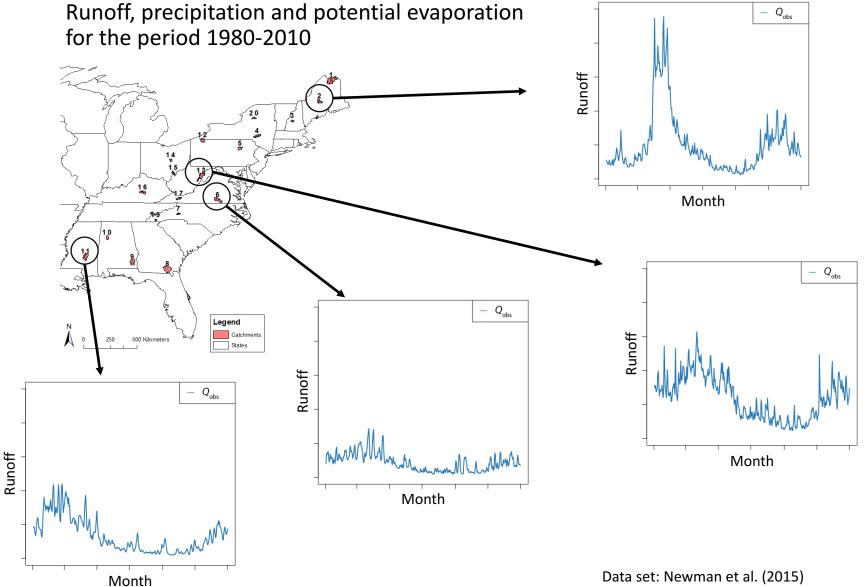
Practical aspect:



Use of hydrological knowledge:

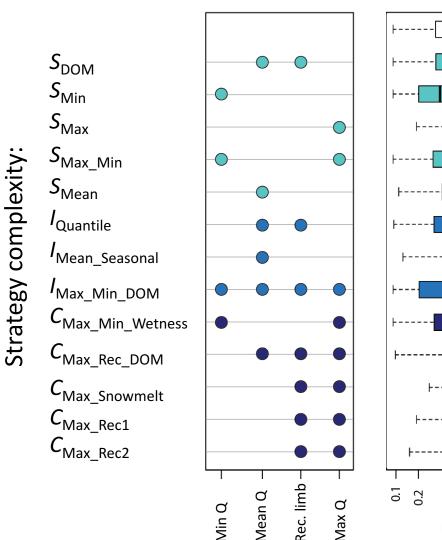


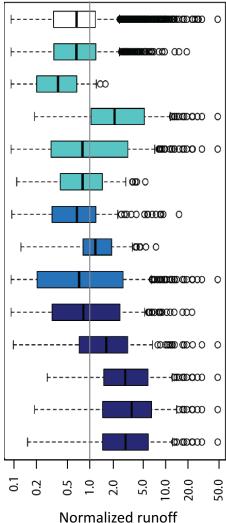
20 catchments across Eastern USA:



13 measurement strategies:

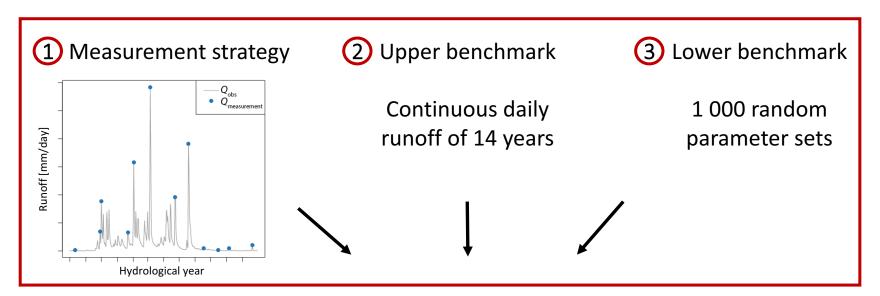
Runoff magnitudes:





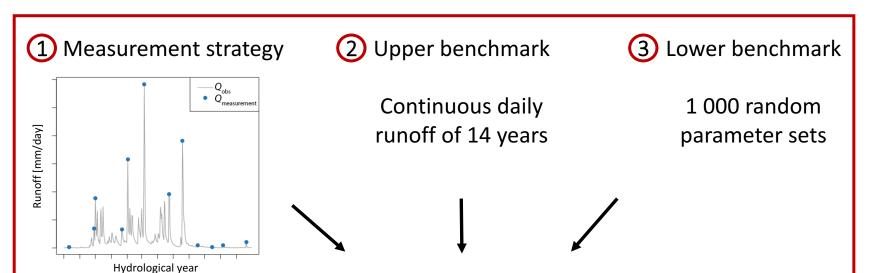
12 runoff measurements per year

Modelling framework:

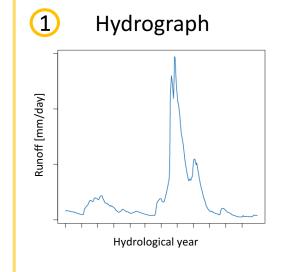


HBV runoff model

Modelling framework:

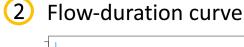


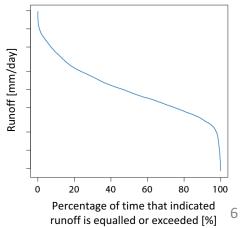
HBV runoff model



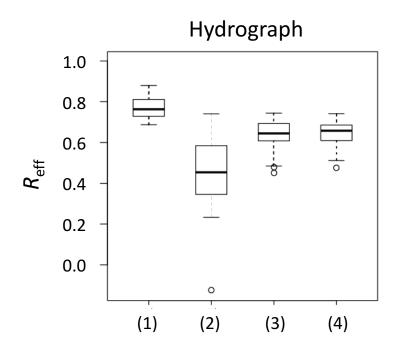


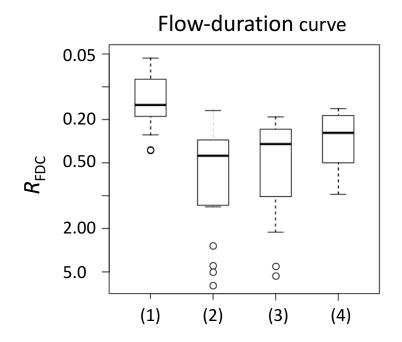
$$R^* = \frac{R_{SS} - R_{lb}}{R_{ub} - R_{lb}}$$





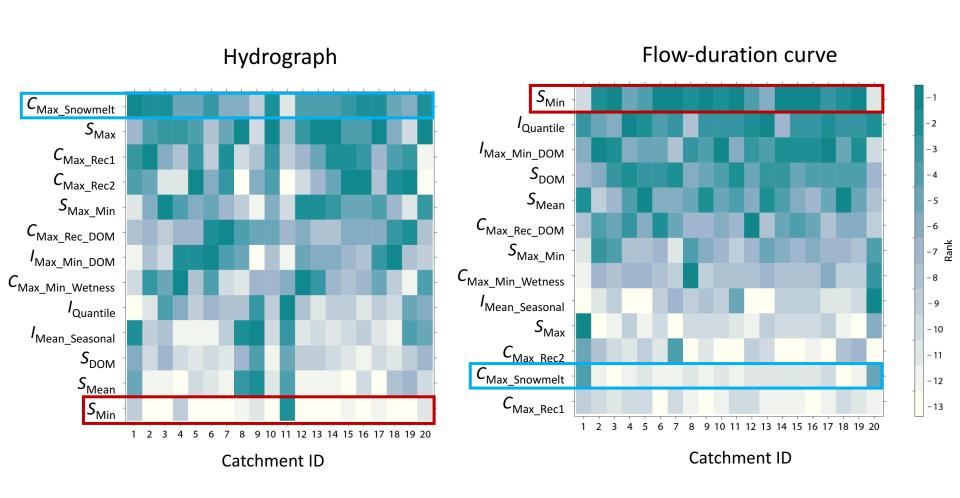
How does the model perform when calibrated with...?



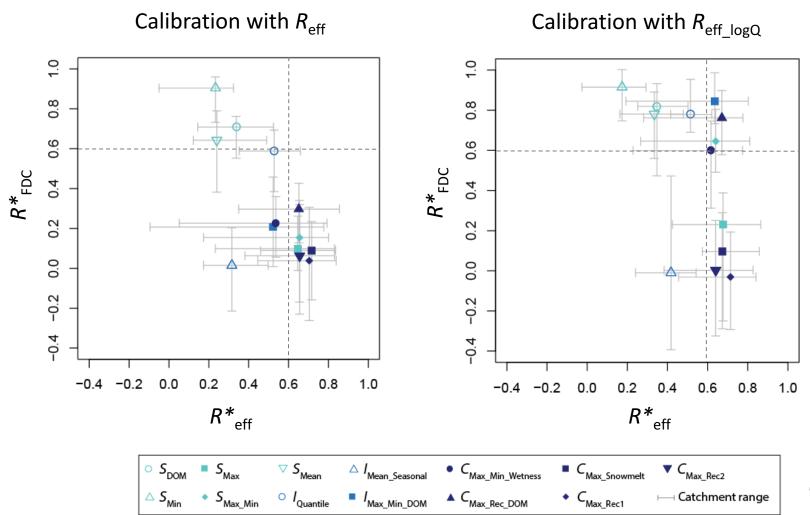


- Upper benchmark (1)
- Lower benchmark (2)
- Measurement strategies using R_{eff} for calibration (3)
- Measurement strategies using $R_{\text{eff logQ}}$ for calibration (4)

Which is the best measurement strategy?



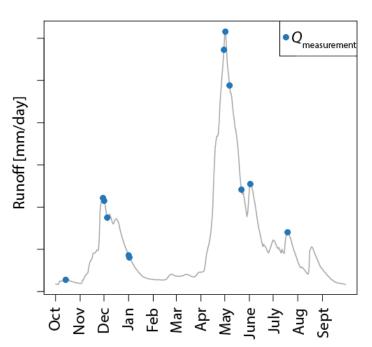
How does the objective function influence the ranking of measurement strategies?



Take home message:

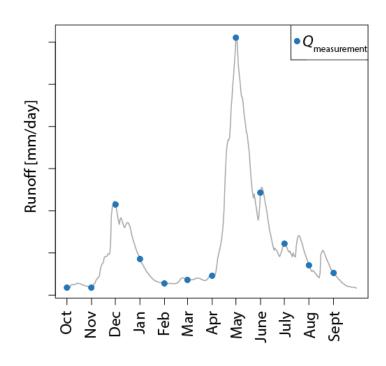
... when would you measure runoff?

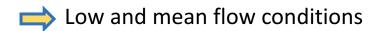
Hydrograph



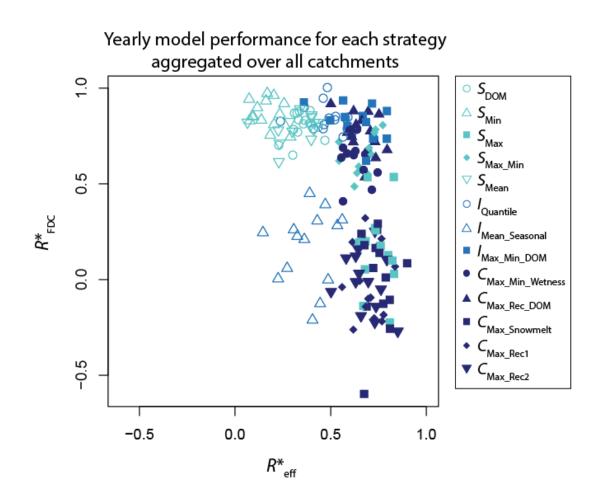
High magnitude with recession data

Flow-duration curve

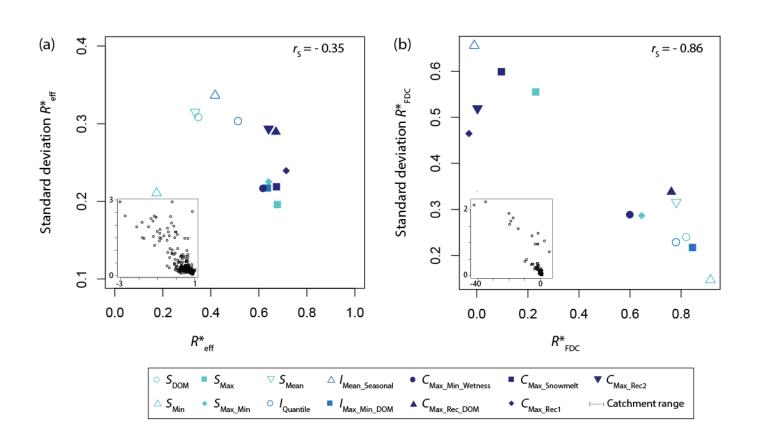




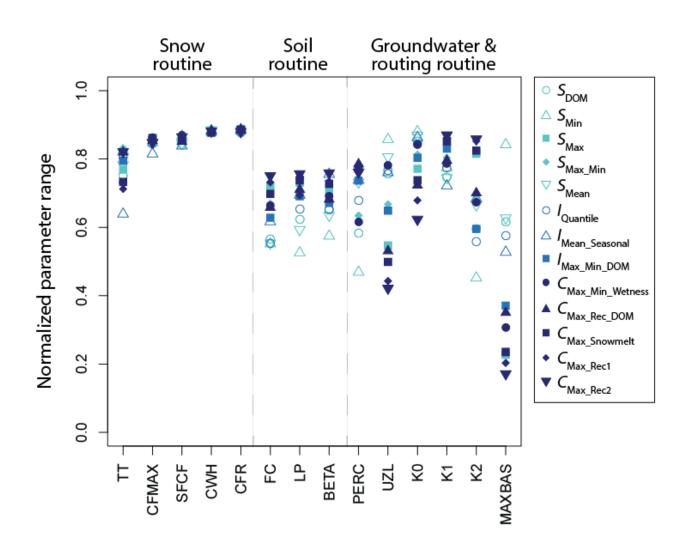
How consistent is the model performance over the 14 single calibration years?



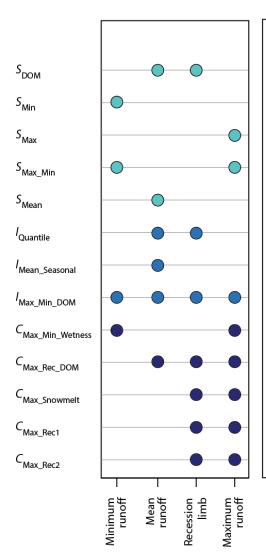
Robustness of the sampling strategies.



How do sampling strategies constrain model parameters?



13 sampling strategies:



Complete runoff data series of hydrological years 1983 to 1996

Measurements at a certain day of a month, e.g. always measure at the 15^{th} day of the month^{a)}

Measurements of the monthly minimum runoff

Measurements of the monthly maximum runoff

Measurements of the bimonthly maximum and minimum runoff

Measurements of the monthly mean runoff

Measurements of twelve quantiles from 0.01 to 0.99 exceedance probability of runoff

Measurements of the biweekly mean runoff of the six months with highest long-term runoff

Measurements of the three highest runoff peaks, three lowest runoff minimas and six measurements at the 15th day of every other month

Measurements of the minimum runoff and two maximum runoff (one after the driest and one after the wettest period) in four three-month time periods

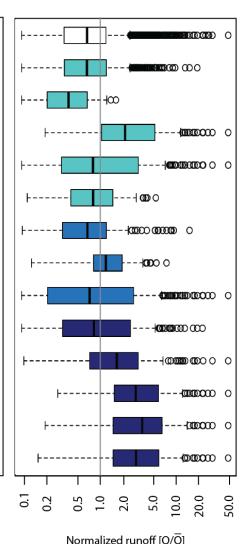
Measurements of the highest runoff peak with the first five subsequent days in its recession and six measurements at the 15th day of every other month

Measurements of ten monthly maximum runoff and two measurements in the recession of the highest runoff event during the snowmelt season^{b)}

Measurements of the four highest runoff peaks and two measurements in the recession of the highest peak in two six-month time periods^{c)}

Measurements of the two highest runoff peaks with three and one measurement in their recession in two six-month time periods^{d)}

Description of sampling strategies



Information:

References

Newman, A. J., Clark, M. P., Sampson, K., Wood, A., Hay, L. E., Bock, A., Viger, R. J., Blodgett, D., Brekke, L., Arnold, J. R., Hopson, T., Duan, Q., 2015. Development of a large-sample watershed-scale hydrometeorological data set for the contiguous USA: Data set characteristics and assessment of regional variability in hydrologic model performance. Hydrol. Earth Syst. Sci. 19, 209–223, http://dx.doi.org/10.5194/hess-19-209-2015