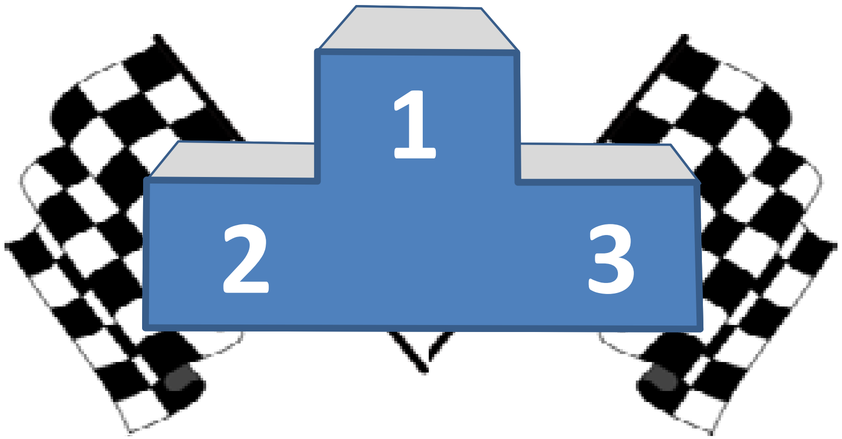
Reconstruction of sedigraphs from intermittent samples – a comparison of multiple data-based methods

The contest of prediction methods for SSC



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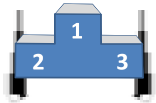
Erosion and Sediments

- erosion (*on-site* effects)
  - Land degradation
  - decreasing productivity
- sediment transport
- deposition in rivers and reservoirs (*off-site* effects)
  - ecological habitat, eutrophication
  - navigability
  - reservoir siltation
  - downstream scouring


Benguê catchment, Brazil

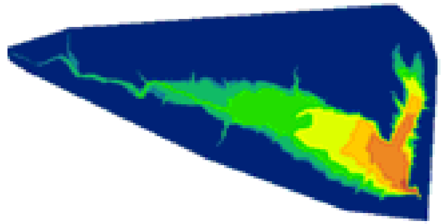

Barasona reservoir, Spain

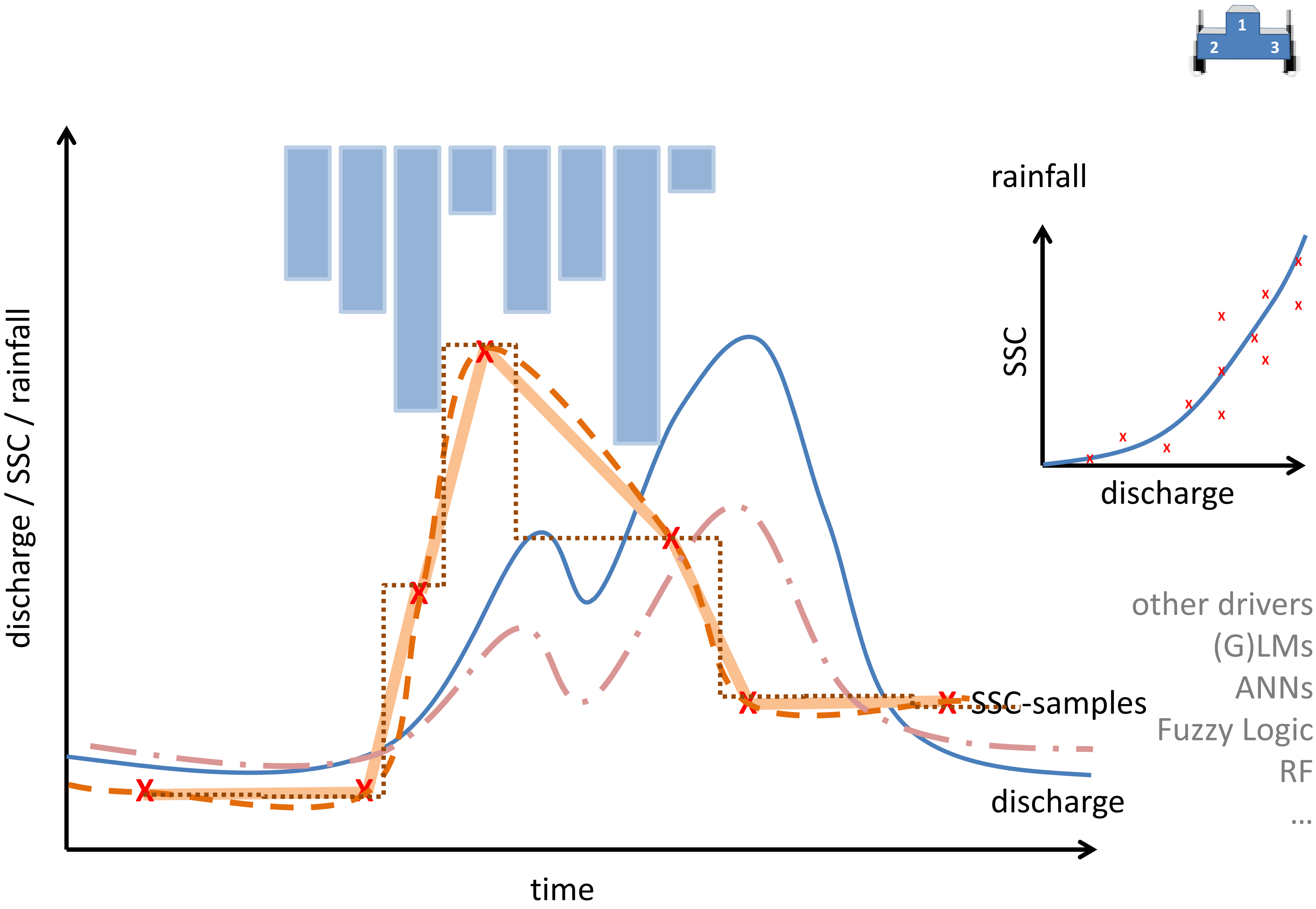

Gibraltar dam, Gibraltar. Ford (2008)



Measurement of sediment fluxes

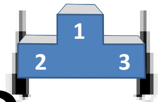
- On-site erosion measurements
  → *n/a beyond hillslope scale*
- Survey of deposition sites
  → *only time-integrated signal*
- Monitoring of sediment flux in the river
  - Continuous: turbidimeter
    → *costly, restricted range*
  - Intermittent: automatic / grab samples
    → ***many available datasets***





Which method is the best?

What constitutes a “good” method?



- accuracy of prediction
- availability and accuracy of uncertainty estimation
- identification of important drivers
- (ease of use)
- (computational and software requirements)

Objective: rank methods for SSC-prediction,
provide selection guide line.

Challenges

1. assessment of accuracy requires comparison with “truth” which is usually unknown for real world systems (intermittency, meas. errors,...)

1. Creating the "truth"

- Modelling of hydrographs from high-resolution rainfall data
- Modelling of sedigraphs from hydrograph (and other drivers)

"Virtual catchment"

- SSC-sampling in "virtual catchment"

Challenges

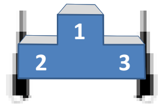
1. assessment of accuracy requires comparison with "truth" which is usually unknown for real world systems (intermittency, meas. errors,...)
2. performance of a method is strongly dependent on the data set

2. Characteristics of data set

Realisations sampled:

- hydrological regime *slow/flashy* 4
- sediment regime *simple/seasons/bank failure* 4
- sample number *hi/medium/lo* 3
- sample scheme *regular/event* 2
- temporal extent *full/half* 2
- predictor selection *Q/Q+P/Q+P+T* 3
- errors in SSC and predictor data 1

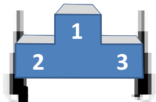
Total #: 864 datasets



Challenges

1. assessment of accuracy requires comparison with "truth" which is usually unknown for real world systems (intermittency, meas. errors,…)
2. performance of a method is strongly dependent on the data set
3. many methods exist; most require advanced expertise

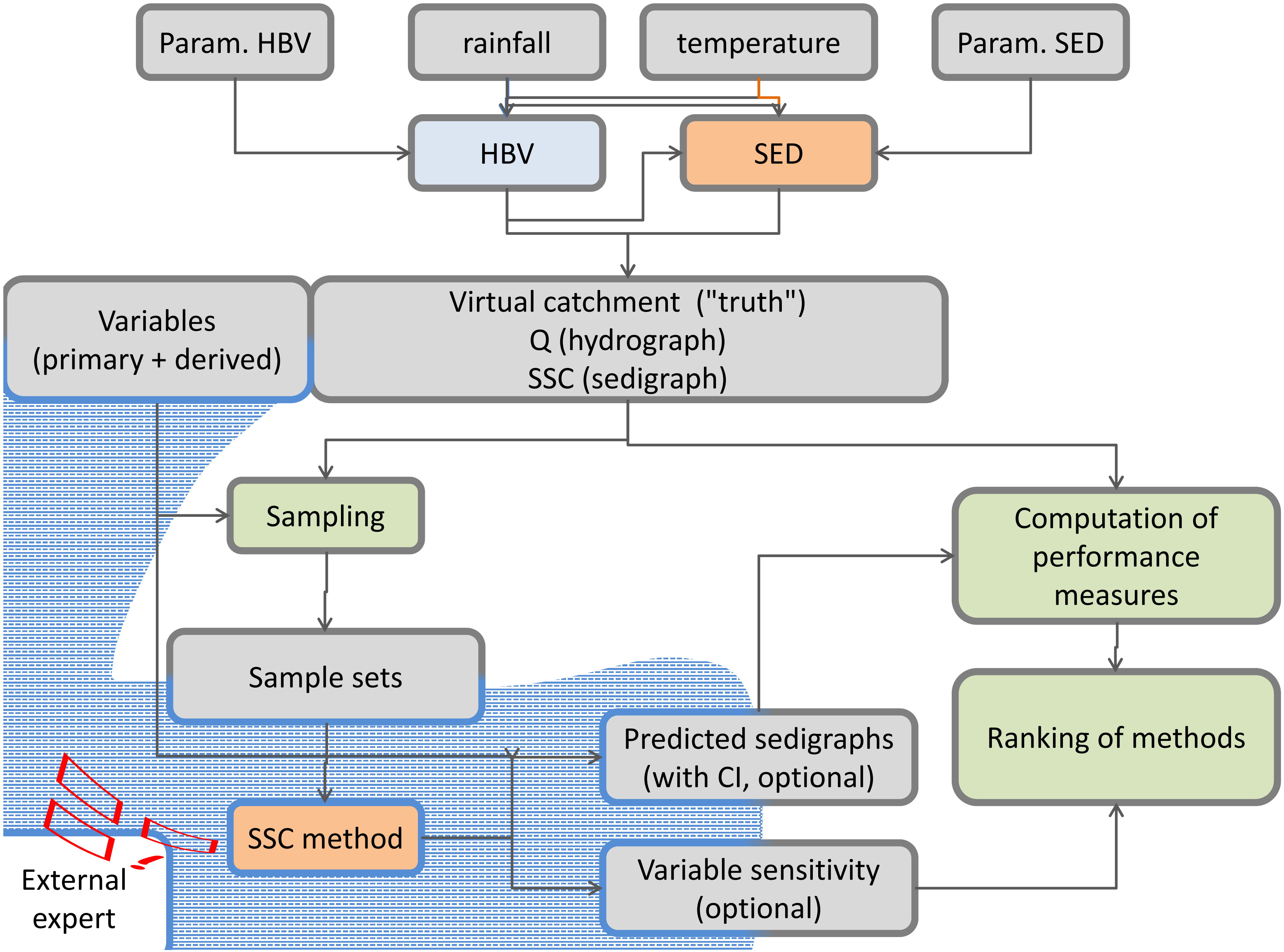
3. Expertise for prediction methods



→involve experienced users, e.g. you!

experienced user

- receives training data
- trains his prediction method
- applies method to validation data and returns results

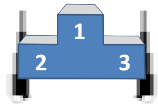

Param. HBV
rainfall
temperature
Param. SED
HBV
SED
Variables
(primary + derived)
Virtual catchment ("truth")
Q (hydrograph)
SSC (sedigraph)
Sampling
Computation of
performance
measures
Sample sets
Predicted sedigraphs
(with CI, optional)
Ranking of methods
SSC method
Variable sensitivity
(optional)
External
expert

Current state

Working routines for

- ✓Generation of virtual catchments
- ✓Generation of training datasets
- ✓[some prediction methods]
- ✓Evaluation of performance of prediction methods

Established methods to be tested



- traditional sediment rating curve (log-fit, non-lin fit)
- SRC with quickflow separation, thresholded SRC
- Linear models (Lasso)
- Generalized Linear Models
- Random Forests
- Quantile Regression Forests
- Conceptual sediment models used in sedigraph generation
- Boosted regression trees
- Multiadaptive regression splines
- Fuzzy Logic
- Artificial Neural Networks
- ANFIS
- ……….add your method here……………………..

implemented

in progress

Your help welcome!

Please join our study!

- You have expertise on a prediction method
- Your method can be automated
- Your method can predict sedigraphs from long timeseries of predictors

OR

- Provide high-resolution time series (rain, runoff, SSC) as prototype for virtual catchments

For details, contact me personally or via francke@uni-potsdam.de

Questions and comments welcome!