Assessing the parameter uncertainty in hydrological modelling by incorporating FSD to the calibration strategy

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Setting the scene

Model calibration as a necessary step in hydrological modelling.

- gradient based methods
- manual calibration bases on expert knowledge
- multi-objective calibration based on different objective criteria
  - different data sources (water-level, flood inundation maps (Dung et al., 2011)
  - different criteria to compute the goodness of fit of one dataset (usually discharge). Moussa and Chahinian (2009) used root-mean-square-error and peakflow prediction

→ addressing the problem of **equifinality**, parameter sets that yield equally good results.

Setting the scene-the study area

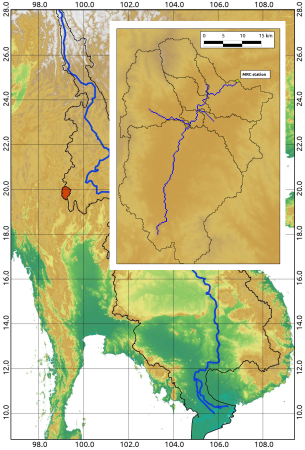

Figure: Overview of the study area

- Nam Mae Fang river in Thailand on the western border of the Mekong catchment (near Chiang Saen).
- headwater catchment with appr. 1800 km^2
- elevation ranges from 200 m to 2200 m
- land-use: 45% heather, 25% forest and 25% cropland (Bontemps et al., 2011)

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NSGA II with 2 objective functions (NSE and pbias)

Method

Model calibration by using the NSGA II algorithm developed by Deb et al. (2000) and the code version implemented by Dung et al. (2011) for the period between 1992 and 2001.

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Results

	NSE	pbias
best NSE	**0.676**	0.1
best pbias	0.675	**0.0**

Table: Results from the standard calibration strategy

NSGA II with 2 objective functions (NSE and pbias)

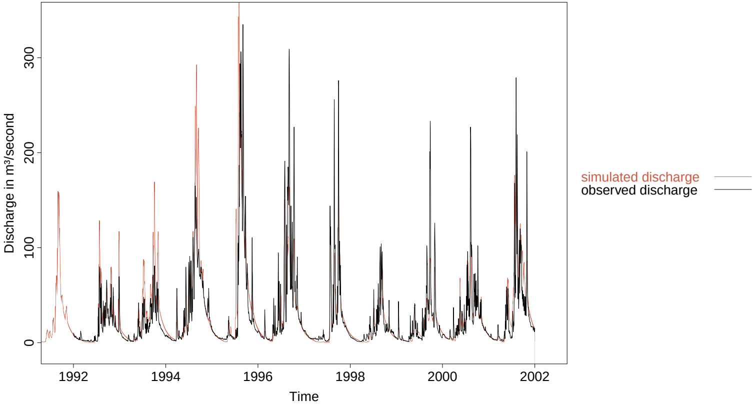

Figure: Simulated vs. observed time series for discharge

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Functional-Streamflow-Disaggregation (FSD)

Decomposition of a discharge time series into 3 parts that match the concept of streamflow components (Carl and Behrendt, 2008; Carl et al., 2008):

base-flow ground water contribution to the stream

inter-flow soil water (subsurface runoff) contribution to the total runoff

fast-flow surface runoff

Functional-Streamflow-Disaggregation (FSD)

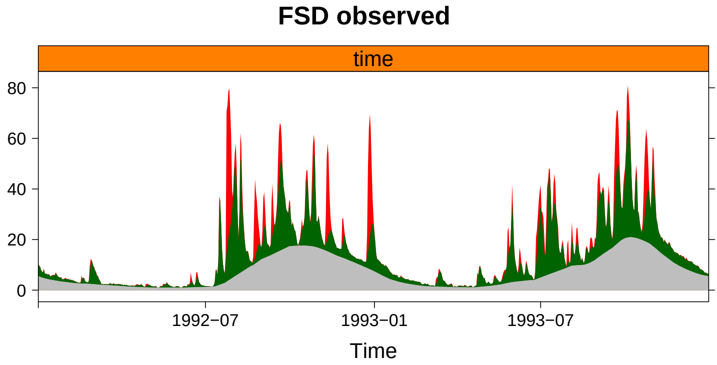

Figure: FSD applied to the observed time series in the Fang catchment. Gray is showing the base-flow, green the inter-flow and red the fast-flow.

Structure of the SWIM flow components

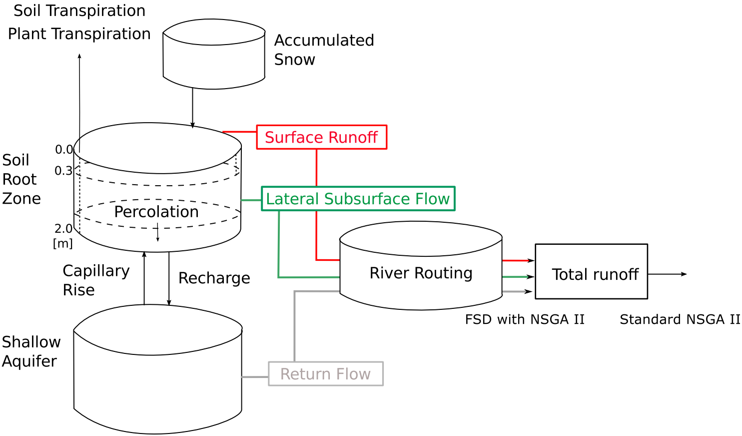

Figure: Simplified structure of the hydrological model SWIM

Results

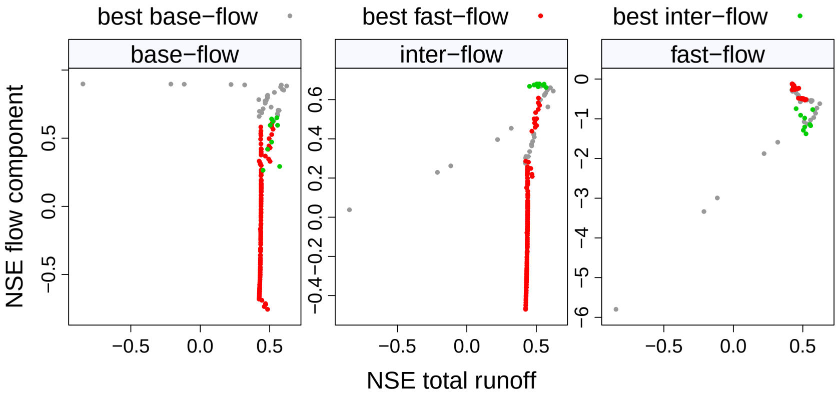

Figure: Goodness of fit measures for each component in relation to the overall model performance based on the same parameter set

Results

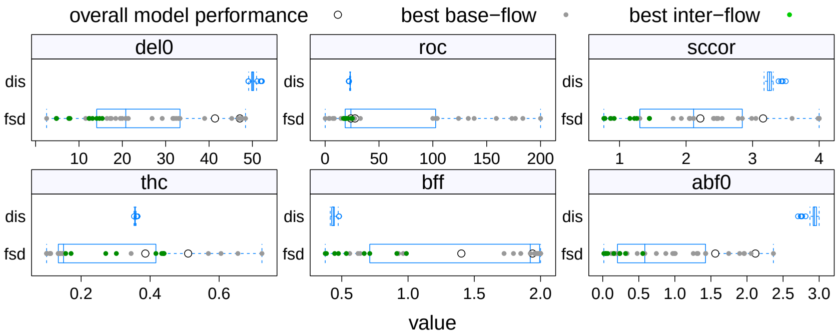

Figure: Parameter combination that yield to a $NSE > 0.6$ for the standard approach (top inside the panel) and the one based on FSD (bottom inside each panel).

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Discussion

1. poor model representation of the fast-flow component
   - the underlying concepts between FSD and SWIM do not match ???
2. a trade-off between the base-flow and inter-flow is given
3. parameter sets differ and show a wider spread for the second approach
4. the overall performance of the "standard" approach in terms of NSE is not reached by the FSD calibration
5. ...

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