Which properties of the data does the model reproduce?

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Motivation

A model is a drastically simplified reproduction of certain observed phenomena. Models depict different properties of the respective data sets to different degrees. Most of the typically used measures of model performance focus on timing and magnitude of runoff peaks, or timing and level of baseflow, etc. We intend to apply a variety of rather uncommon measures that represent different statistical properties of the sets of observed and simulated data. Here, only first results are shown.

First Results

The model was run 10000 times using a Monte Carlo approach. The best model yielded a Pearson r^2 of 0.85 both for the calibration and for the validation period (Fig. 1). It is remarkable that the performance of the model for the validation period hardly differs from that of the calibration period with respect to a variety of different measures. Thus, it is concluded that overtraining has not to be accounted for.

The cumulative density curve shows that the model tends to overestimate minor discharge peaks, and to underestimate moderate runoff peaks (Fig. 2). Besides, the model overestimates the autocorrelation of the data (Fig. 3), whereas it underestimates both the magnitude and the time lag of maximal cross-correlation with precipitation (Fig. 4).

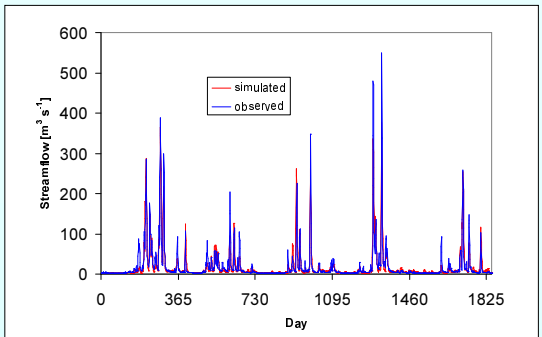

Fig. 1: Observed and simulated streamflow for the validation period.

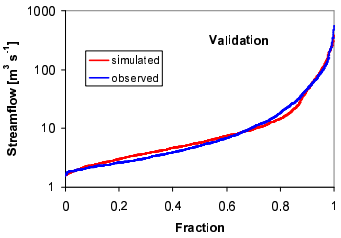

Fig. 2: Cumulative density function of the observed and the simulated data set for the validation period.

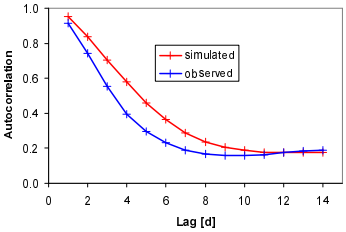

Fig. 3: Autocorrelation of the observed and the simulated data set for the calibration period.

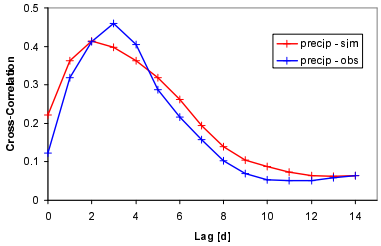

Fig. 4: Cross-correlation between precipitation and streamflow for the calibration period.

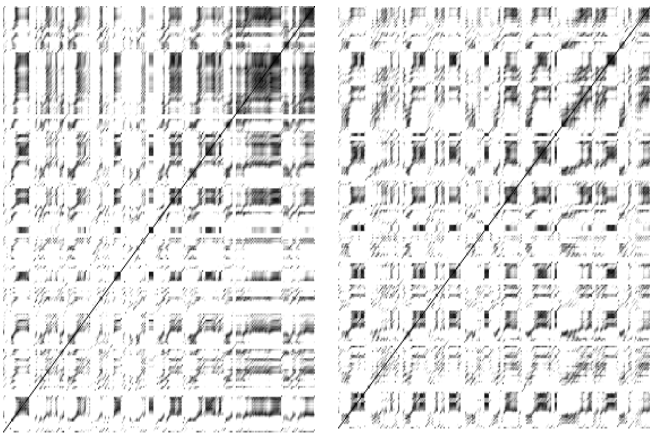

Fig. 5: Cross-recurrence of observed and simulated SO_4 concentration in the Lehstenbach catchment runoff (Lischeid et al. 2004).

Further Work

We plan to apply a couple of non-linear methods to characterize the properties of the observed and of the simulated data set, including:

- Power Spectrum
- Hurst Statistics
- Fluctuation Complexity and Mean Informatin Gain
- Recurrence Plots and Recurrence Quantification Analysis
- Wavelets
- Artificial Neural Networks

Here, only one example is given. The performance of a SO_4 model was analysed using recurrence plots both for the observed and for the simulated time series (Fig. 5). In this plot, time runs from left to right along the x-axis, and from bottom to top along the y-axis. White pixels in the graph denote differences between the values of the two dates that exceed a certain threshold value, and black pixels differences that do not. The graph clearly shows that the model overestimates the regularity of temporal patterns of the data in the later part of the simulated period (upper right corner of the graph). The Recurrence Quantification Analysis gives a quantitative measures for that regularity (not shown).

References

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