LEAF River Data: DBM Modelling and Flow Forecasting

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OBJECTIVES:

The Leaf River Data: Inductive DBM Modelling

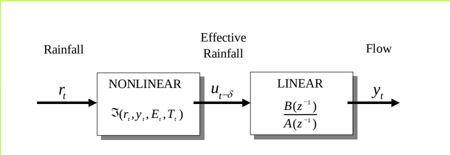
TOOLS:

* Non-Parametric State Dependent Parameter (SDP) Analysis
* Parametric Estimation of the DBM Model
* Kalman Filter-based Forecasting and Fixed Interval Smoothing

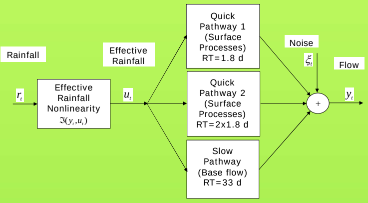
(1) Based on prior data analysis
(2) Optimized by prediction error decomposition

DISCUSSION

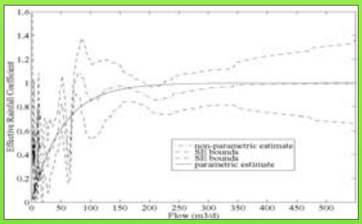
A Generic Form for DBM & Most Top-Down, Rainfall-Flow Models



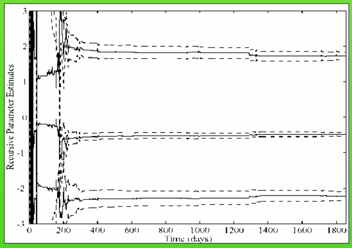
Leaf River DBM Model: Parallel-Flow Decomposition and Physical Interpretation



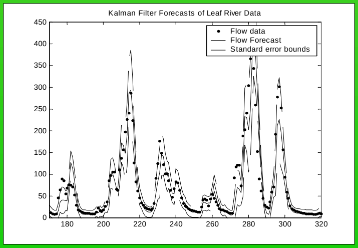
SDP Estimation of the Effective Rainfall Nonlinearity



Recursive parameter estimates

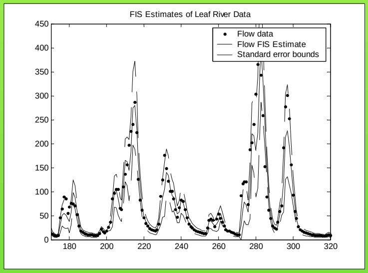


The Leaf River: SDP-KF Forecasting and Fixed Interval Smoothing: preliminary results Based on prior analysis of data

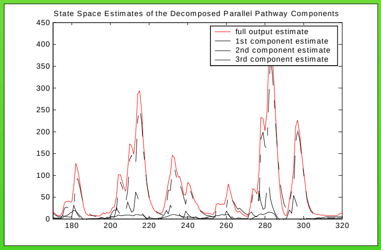


The Leaf River: SDP-KF Forecasting and Fixed Interval Smoothing

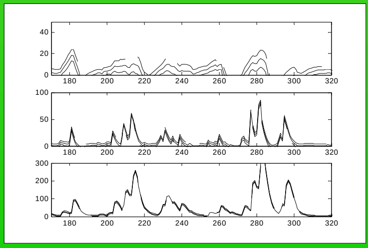
Optimization based on prediction error decomposition



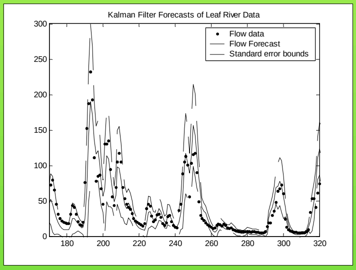
State space estimates of the decomposed parallel pathway components



Confidence limits of the decomposed parallel pathway components



Validation of KF model



Conclusions and Results:

- Time series analysis of most rainfall-flow data suggests a ‘Hammerstein’ model structure in which an ‘effective rainfall’ nonlinear process is in series with a low order linear transfer function that characterizes the underlying unit hydrograph of the catchment.
- The *en-bloc or* recursive (analytic Bayesian) *Refined Instrumental variable* (RIV) algorithm provides a simple but statistically sound method of identification and estimation for this model, which can be interpreted in a *Data-Based Mechanistic (DBM)* model form.
- The SDP-KF and SDP-FIS algorithms, based on the state-space form of the SDP-DBM model, provide the main engines for recursive (if necessary adaptive) forecasting, data assimilation and smoothing.
- More complex and computationally intensive numerical Bayesian methods do not appear essential for this kind of DBM model.
- *All* rainfall-flow models will benefit from more research on the nature of the effective rainfall nonlinearity and the best ways to incorporate distributed (spatial) information in order to produce aerial forecasts.
- All the results reported here were obtained using SDP, RIV, KF and FIS algorithms available in the CAPTAIN Toolbox for Matlab (see our web page).