Short Course on Bayesian Uncertainty Analysis in Hydrological Modeling

by Dmitri Kavetski and Peter Reichert, April 11-13, 2008, EGU, Vienna

Venue: seminar room of the Faculty of Civil Engineering (*Bauingenieurwesen*, abbreviated *BI* in German), see map at http://www.bauwesen.tuwien.ac.at/uebersichtsplan.htm.

Time table	Date	Day		Start time
Block 1	11.4.2008	Friday	afternoon	14:30
Block 2	12.4.2008	Saturday	morning	to be announced
Block 3	12.4.2008	Saturday	afternoon	to be announced
Block 4	13.4.2008	Sunday	morning	to be announced

Block 1: Concepts of Bayesian Inference and Prediction

60 min	PR	Concepts of frequentist and Bayesian statistics. Formulation of models, construction of likelihood functions (distributional assumptions, transformations, autoregressive error models, bias). Formulating prior knowledge. Simple examples with analytical solution (conjugate prior-likelihood pairs). Introduction to sampling. Predictive use of inferred models.
10 min		break
60 min	DK	Hierarchical Bayesian models, the "error-in-variables" framework. Basic analysis of the posterior using optimisation and Hessian-based methods. Model diagnostics: residuals, posterior plots of latent variables, predictive QQ plots. Inabilities to infer multiple error variances with non-informative priors.
10 min		break
20 min	PR	Introduction to R (all participants should install R on their laptop, see http://www.r-project.org/)
20 min		Basic exercises in R

Block 2: Bayesian Numerics / Applications to Hydrology

60 min	PR	Introduction to concepts underlying Monte Carlo techniques. Importance sampling. Markov Chain Monte Carlo.
10 min		break
60 min	DK	Sequential Monte Carlo (particle filters). Population Monte Carlo. Practical implementation aspects: Hybrid MC/Importance methods, block-MCMC methods, speed-ups, multi-start pre-optimisation and covariance estimation.
10 min		break
40 min		Exercises in MCMC

Block 3: Outlook to Recent Developments in Applications to Hydrology

60 min	DK	Input uncertainty, BATEA, robust model implementation and smoothing.
10 min		break
60 min	PR	Time dependent parameters for analyzing model stuctural errors and input uncertainty. Use of emulators as one option for improving numerical efficiency.
10 min		break
40 min		Exercises

Block 4: Discussion of Problems of Participants

Please come with questions about your own work.