

Environmental Models and Bayesian Inference

Lecturers and organizers: Dmitri Kavetski (University of Adelaide) and Juliane Mai (University of Waterloo)

Target audience

Master students, PhD students and PostDocs with basic mathematical, statistical and computational background.
(maximal number of participants: 15)

Assumed knowledge in mathematical modeling: Basic calculus and ordinary differential equations

Assumed knowledge in statistics: Basic properties of probability distributions, including the Gaussian and exponential distributions

Assumed programming skills: Able to develop and run standalone scripts in a language such as Matlab, Python, R or Excel

Please send the attached **application letter** to juliane.mai@uwaterloo.ca **latest at February 10th**. You will get notified at February 13th if you were selected to attend the course. The decision will be based on your skills and objectives you described in the letter.

Contents

1. Development of models using conservation of mass principles and process conceptualization
2. Model development numerics (time stepping schemes, spatial approximations, etc)
3. Sensitivity analysis
4. Calibration and prediction using mathematical models; Posterior diagnostics including residual error analysis
5. Programming aspects

Didactic aim

Cover essential modeling concepts in environmental/ hydrological modeling: model development, inference, sensitivity analysis and prediction. At the end of this course, participants are expected to be able to:

- (a) list and understand key concepts in environmental/hydrological modeling
- (b) design and implement a hydrological model with a few nonlinear reservoirs
- (c) identify important model parameters using screening methods
- (d) estimate parameter sensitivities using Sobol' analysis
- (e) calibrate a simple hydrological model using Bayesian least squares methods
- (f) generate and appraise probabilistic predictions including parametric and residual uncertainty
- (g) be aware of principles underlying more sophisticated Bayesian inference and prediction methods

Remarks

- when registering, participants must send a short letter (1/2 page) to juliane.mai@uwaterloo.ca explaining their background (education, field of research, programming skills), their motivation to attend the course (which applications, which problems they want to address) and their expectations (what they expect to learn).
- participants should bring their own laptop with them for the exercises
- programs required: Excel, Matlab, Python are recommended
- Windows PC needed to use some of the modeling software (but maybe you find a partner during the course who has a Windows PC)