Geophysical Research Abstracts
Vol. 12, EGU2010-8039, 2010
EGU General Assembly 2010

Estimating parameter and predictive uncertainty when model residuals are correlated, heteroscedastic, and non-Gaussian

Gerrit Schoups (1) and Jasper A. Vrugt (2,3)

(1) Department of Water Management, Delft University of Technology, The Netherlands (gerrit.schoups@gmail.com), (2) Department of Civil and Environmental Engineering, University of California, Irvine, USA, (3) Center for NonLinear Studies, Los Alamos National Laboratory, Mail Stop B285, Los Alamos, NM 87545, USA

Estimation of parameter and predictive uncertainty of hydrologic models usually relies on the assumption of additive residual errors that are independent and identically distributed according to a normal distribution with a mean of zero and a constant variance. Here, we investigate to what extent estimates of parameter and predictive uncertainty are affected when these assumptions are relaxed. Parameter and predictive uncertainty are estimated by Monte Carlo Markov Chain sampling from a generalized likelihood function that accounts for correlation, heteroscedasticity, and non-normality of residual errors. Application to rainfall-runoff modeling using daily data from a humid basin reveals that: (i) residual errors are much better described by a heteroscedastic, first-order auto-correlated error model with a Laplacian density characterized by heavier tails than a Gaussian density, and (ii) proper representation of the statistical distribution of residual errors yields tighter predictive uncertainty bands and more physically realistic parameter estimates that are less sensitive to the particular time period used for inference. The latter is especially useful for regionalization and extrapolation of parameter values to ungauged basins. Application to daily rainfall-runoff data from a semi-arid basin shows that allowing skew in the error distribution yields improved estimates of predictive uncertainty when flows are close to zero.