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Parameter identifiability and regional calibration for reservoir inflow prediction

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The large hydropower producer Statkraft is currently testing regional, distributed models for operational reservoir inflow prediction. The need for simultaneous forecasts and consistent updating in a large number of catchments supports the shift from catchment-oriented to regional models. Low-quality naturalized inflow series in the reservoir catchments further encourages the use of donor catchments and regional simulation for calibration purposes.

MCMC based parameter estimation (the Dream algorithm; Vrugt et al, 2009) is adapted to regional parameter estimation, and implemented within the open source ENKI framework. The likelihood is based on the concept of effectively independent number of observations, spatially as well as in time. Marginal and conditional (around an optimum) parameter distributions for each catchment may be extracted, even though the MCMC algorithm itself is guided only by the regional likelihood surface.

Early results indicate that the average performance loss associated with regional calibration (difference in Nash-Sutcliffe R2 between regionally and locally optimal parameters) is in the range of 0.06. The importance of the seasonal snow storage and melt in Norwegian mountain catchments probably contributes to the high degree of similarity among catchments. The evaluation continues for several regions, focusing on posterior parameter uncertainty and identifiability.

Vrugt, J. A., C. J. F. ter Braak, C. G. H. Diks, B. A. Robinson, J. M. Hyman and D. Higdon: Accelerating Markov Chain Monte Carlo Simulation by Differential Evolution with Self-Adaptive Randomized Subspace Sampling. Int. J. of nonlinear sciences and numerical simulation 10, 3, 273-290, 2009.