Geophysical Research Abstracts,
Vol. 11, EGU2009-7942, 2009
EGU General Assembly 2009

Testing calibration routines for LISFLOOD, a distributed hydrological model

B. Pannemans

JRC - European Commission, IES - LMU - Floods Action, Ispra, Italy (bart.pannemans@jrc.it, 0039-033278 6653)

Traditionally hydrological models are considered as difficult to calibrate: their highly non-linearity results in rugged and rough response surfaces were calibration algorithms easily get stuck in local minima. For the calibration of distributed hydrological models two extra factors play an important role: on the one hand they are often costly on computation, thus restricting the feasible number of model runs; on the other hand their distributed nature smooths the response surface, thus facilitating the search for a global minimum.

Lisflood is a distributed hydrological model currently used for the European Flood Alert System – EFAS (Van der Knijff et al, 2008). Its upcoming recalibration over more then 200 catchments, each with an average runtime of 2-3 minutes, proved a perfect occasion to put several existing calibration algorithms to the test. The tested routines are Downhill Simplex (DHS, Nelder and Mead, 1965), SCEUA (Duan et Al. 1993), SCEM (Vrugt et al., 2003) and AMALGAM (Vrugt et al., 2008), and they were evaluated on their capability to efficiently converge onto the global minimum and on the spread in the found solutions in repeated runs.

The routines were let loose on a simple hyperbolic function, on a Lisflood catchment using model output as observation, and on two Lisflood catchments using real observations (one on the river Inn in the Alps, the other along the downstream stretch of the Elbe).

On the mathematical problem and on the catchment with synthetic observations DHS proved to be the fastest and the most efficient in finding a solution. SCEUA and AMALGAM are a slower, but while SCEUA keeps converging on the exact solution, AMALGAM slows down after about 600 runs.

For the Lisflood models with real-time observations AMALGAM (hybrid algorithm that combines several other algorithms, we used CMA, PSO and GA) came as fastest out of the tests, and giving comparable results in consecutive runs. However, some more work is needed to tweak the stopping criteria. SCEUA is a bit slower, but has very transparent stopping rules. Both have closed in on the minima after about 600 runs.

DHS equals only SCEUA on convergence speed. The stopping criteria we applied so far are too strict, causing it to stop too early.

SCEM converges 5-6 times slower. This is a high price for the parameter uncertainty analysis that is simultaneously done.

The ease with which all algorithms find the same optimum suggests that we are dealing with a smooth and relatively simple response surface. This leaves room for other deterministic calibration algorithms being smarter than DHS in sliding downhill. PEST seems promising but sofar we havent́ managed to get it running with LISFLOOD.

• Duan, Q.; Gupta, V. & Sorooshian, S., 1993, Shuffled complex evolution approach for effective and efficient global minimization, J Optim Theory Appl, Kluwer Academic Publishers-Plenum Publishers, 76, 501-521

• Nelder, J. & Mead, R., 1965, A simplex method for function minimization, Comput. J., 7, 308-313

• Van Der Knijff, J. M.; Younis, J. & De Roo, A. P. J., 2008, LISFLOOD: a GIS-based distributed model for river basin scale water balance and flood simulation,
International Journal of Geographical Information Science,

• Vrugt, J.; Gupta, H.; Bouten, W. & Sorooshian, S., 2003, A Shuffled Complex Evolution Metropolis algorithm for optimization and uncertainty assessment of hydrologic model parameters, Water Resour. Res., 39

• Vrugt, J.; Robinson, B. & Hyman, J., 2008, Self-Adaptive Multimethod Search for Global Optimization in Real-Parameter Spaces, IEEE Trans Evol Comput, IEEE,