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# Parameter identification of a distributed runoff model by the optimization software Colleo

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The introduction of Colleo (Collection of Optimization software) is presented and case studies of parameter identification for a distributed runoff model are illustrated.

In order to calculate discharge of rivers accurately, a distributed runoff model becomes widely used to take into account various land usage, soil-type and rainfall distribution. Feasibility study of parameter optimization is desired to be done in two steps. The first step is to survey which optimization algorithms are suitable for the problems of interests. The second step is to investigate the performance of the specific optimization algorithm. Most of the previous studies seem to focus on the second step. This study will focus on the first step and complement the previous studies.

Many optimization algorithms have been proposed in the computational science field and a large number of optimization software have been developed and opened to the public with practically applicable performance and quality. It is well known that it is important to use suitable algorithms for the problems to obtain good optimization results efficiently. In order to achieve algorithm comparison readily, optimization software is needed with which performance of many algorithms can be compared and can be connected to various simulation software. Colleo is developed to satisfy such needs. Colleo provides a unified user interface to several optimization software such as pyOpt, NLopt, inspyred and R and helps investigate the suitability of optimization algorithms. 74 different implementations of optimization algorithms, Nelder-Mead, Particle Swarm Optimization and Genetic Algorithm, are available with Colleo.

The effectiveness of Colleo was demonstrated with the cases of flood events of the Gokase River basin in Japan (1820km$^2$). From 2002 to 2010, there were 15 flood events, in which the discharge exceeded 1000m$^3$/s. The discharge was calculated with the PWRI distributed hydrological model developed by ICHARM. The target area was partitioned into grids. Two-layer tanks were placed on each grid. There were 12 parameters to be optimized representing flow and infiltration. An objective function was an error between calculated and measured discharge and three error functions were used: a mean square error, a relative error and a log error. The number of iterations was set to 144.

Applying 74 optimization algorithms to the cases of 15 flood events with three error functions, 13 optimization algorithms were selected that achieve the smallest error in at least one optimization case. Then, we selected one of the optimization cases for each flood event. In each case, the fitting of calculated and measured discharge was good. In practical usage in Japan, a SCE-UA optimization algorithm is widely used with a lumped model. The optimization performance was compared between SCE-UA and Colleo. For all cases, at least one optimization algorithm of Colleo was superior to SCE-UA with a small number of convergent calculation.

Using Colleo, we clarified the performance of a promising 13 optimization algorithms for a distributed runoff model, some of which may be yet unseen in hydroinformatics and showed that some optimization algorithms were more efficient than SCE-UA with a small number of convergent calculation.