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Calibration of the analogue method for precipitation forecasting by means of genetic algorithms

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The analogue downscaling technique allows precipitation forecasting on the basis of the synoptic circulation and humidity variables resulting from a global circulation model (GCM). The method identifies analog days in a long archive of past situations and uses their observed precipitation amount to build the empirical conditional distribution considered as the probabilistic forecast for the target day.

The Atmoswing model (Analog Technique MOdel for Statistical Weather forecastING) was developed to calibrate the method and to process real-time forecasting in the Swiss Alps. It is part of the MINERVE project, which aims at reducing the flood peaks of the Rhône River by means of water retention in dams.

Such a method is highly non-linear, works with both discrete and continuous variables and has a complex cost surface. Calibration with linear methods such as a simplex concept has been tried, but has led to unsatisfying results. The complexity of the analogue technique gives the user no choice but to use either a step-by-step manual calibration or a global optimizer. While the first option is the commonly used approach, a global optimizer has never been used to fulfill that goal. The classic calibration's main issue is that parameters are not independent and the choices made in the beginning of the calibration procedure have an impact on the final set. We decided to implement the genetic algorithms to achieve the model calibration, and so to avoid subjective choices of initial parameters.

Genetic algorithms exist with multiple operators (natural selection, mating selection, chromosomes crossover, and mutation) variations and specific parameterizations. Most used implementations were compared to choose the version resulting in the best calibration with the minimum processing time. Afterwards, the optimizer is used to explore new variable spaces and even to choose the best atmospheric variables, what was not possible in the traditional calibration procedure.