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Global optimization of the Analogue Method by means of Genetic Algorithms

Pascal Horton (1), Michel Jaboyedoff (1), and Charles Obled (2)

(1) Research Center on Terrestrial Environment (CRET), University of Lausanne, Lausanne, Switzerland (pascal.horton@unil.ch), (2) Laboratoire d'étude des Transferts en Hydrologie et Environnement (LTHE) UMR5564, Grenoble-INP, Grenoble, France

The analogue method allows for statistical precipitation forecasting on the basis of the synoptic atmospheric circulation and humidity variables resulting from a global numerical weather prediction model. It identifies analogue days in a long archive of past situations and uses the corresponding measured precipitation amount to establish an empirical conditional distribution considered as the probabilistic forecast for the target day. Successive analogy steps on different atmospheric variables help refining the forecast by subsampling in the chosen analogue days.

The analogue method must be adapted to every new region where it is applied. This requires identifying relevant predictor variables, and optimizing number of parameters such as atmospheric levels, spatial and temporal windows. The classic calibration is a semi-automatic approach that contains numbers of manual steps, e.g. the atmospheric levels and the temporal windows are initially chosen. This means that every combination must be assessed to identify the best parameterization.

Due to the limitations of the classic calibration, we propose to use a global optimization technique in order to automatically and objectively identify the parameters that work best jointly. We thus used the genetic algorithms technique and assessed systematic combinations of operators to analyze their performance and the sensitivity of the optimization. We have then identified that the mutation operator has a critical role in our application. Genetic algorithms allow for automatic selection of every parameter used in the analogue method, including the atmospheric levels and the temporal windows.

Genetic algorithms succeeded in optimizing the analogue method and allowed us to identify interdependences between parameters, atmospheric levels and analogy steps. We could also add new degrees of freedom, such as independent spatial windows between atmospheric levels for the synoptic circulation analogy, as well as a weighting of these levels. Results for various sub-regions showed interesting and clear tendencies in terms of location and size of the spatial windows.