Geophysical Research Abstracts, Vol. 7, 07262, 2005
SRef-ID: 1607-7962/gra/EGU05-A-07262

Is the groundwater reservoir linear? Learning from data in hydrological modelling.

F. Fenicia (1,2), H. H.G. Savenije (2), P. Matgen (1), L. Pfister (1)

(1) Public Research Center – Gabriel Lippmann, 162a Avenue de la Faïencerie, L-1511 Luxembourg, (2) Water Resources Section, Faculty of Civil Engineering and Geosciences, Delft University of Technology, P.O. Box 5048, 2600 GA Delft, The Netherlands (fenicia@crpgl.lu / Phone: +352 470261-405)

Although the catchment behavior during recession periods appears to be better identifiable than in other periods, the representation of hydrograph recessions is often a weak point of hydrological simulations. Reasons could be that the objective functions often used for model calibration give more weight to an accurate representation of peak flows rather than low flows, or that the conceptualization of the catchment is not appropriate for a correct simulation of flow recessions.

In most conceptual hydrological models the recession curve of a hydrograph is represented as an emptying reservoir. The form of the storage discharge relation, however, differs. In some cases a linear function is adopted; in other cases different forms are preferred. In this paper, we try to determine the form of this relation, and we calibrate it to simulate the observed hydrograph recessions. For this purpose we use a simple conceptual model structure. The model is designed to reproduce specific hydrograph characteristics and is composed of four reservoirs: an interception reservoir, an unsaturated soil reservoir, a fast reacting reservoir, and a slow reacting reservoir.

We have followed a "top-down" approach where we determine the functional relation between the discharge and the storage of the slow reacting reservoir without making any prior assumption on the form of this relation, but deriving it directly from the data that are observed. Based on the recorded discharge we calculate a synthetic master recession curve that we use to derive a first estimate of the storage-discharge relationship. Subsequently, we calibrate other model parameters, and then correct the initial estimate using the modeled percolation flux that enters the slow reacting reservoir.

In the calibration phase we separate the calibration of low flows from high flows because we consider them to be related to separate processes, which can be separately identified. This way we try to avoid that the simulation of low discharges is neglected in favor of good performances in the simulation of peak discharges. We have applied this analysis on several catchments in Luxembourg, and in each case we have determined which form (linear or non linear) of the storage discharge relation is best to describe the slow reacting reservoir.