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Numerical exploration of the dynamics of infiltration in hill reservoir

Maroua Bouteffeha¹, Cécile Dages², Jérôme Molénat², and Rachida Bouhlila¹

¹Tunis El Manar University, National School of Engineering of Tunis, LMHE, 1002 Tunis Belvédère, Tunisia

²UMR LISAH, Université de Montpellier, INRAE, IRD, Institut Agro, Montpellier, France

Hill reservoirs are small dams intercepting stream runoff in headwater catchment. These reservoirs have been increasingly used in arid and semi-arid regions, in order to provide water for irrigation and farming. Understanding the hydrological functioning of these reservoirs and especially the losses due to infiltration through the reservoir bed is important in order to improve reservoir management practices notably in mediterranean basin threatened with climatic change and water scarcity.

The present work aims to explore numerically the dynamic of infiltration through the reservoir bed in relation to the water level variation in reservoir. The approach is based on a modeling study of a 2D flow model with the Hydrus model. The simulated domain represents a longitudinal section of the hill reservoir. Different scenarios with three different forms of variations of the daily water level in the reservoir were tested. We also considered different hydraulic properties of porous media underlying the reservoir bed to analyse their effects on the infiltration rate.

The monthly dynamics of simulated infiltration rate in real conditions was consistent with the monthly infiltration estimated in Bouteffeha et al., (2015) based on a hydrological water balance approach. Furthermore, daily infiltration rate seems to vary according to the variation of the reservoir water level. For all scenarios of reservoir water level dynamics and hydraulic properties, the numerical exploration shows that the relationship between infiltration rate and daily water level is hysteretic, involving different infiltration rates for the rising and the recession phases for given water level. As a consequence, linear relationship usually used in hydrologic model to simulate infiltration from reservoir may lead to significant errors, particularly during the rising phase in the wet season when the reservoir is filling up.

References:

Bouteffeha, M., Dages, C., Bouhlila, R., et Molénat, J. (2015). A water balance approach for quantifying subsurface exchange fluxes and associated errors in hill reservoirs in semiarid regions. *Hydrological Processes*, 29(7), 1861-1872