Mushombe Muma et al., J Geol Geophys 2018, Volume 7
DOI: 10.4172/2381-8719-C2-020

Assessment of the impact of subsurface agricultural drainage on soil water storage and flow of a small watershed

Mushombe Muma[1], **Silvio J Gumiere**[2] and **Alain N Rousseau**[3]
[1]New Horizons University, Congo
[2]Université Laval, Canada
[3]Centre ÉTÉ - INRS, Canada

3D hydrological modeling was performed, using CATHY (acronym for Catchment Hydrology model), with the basic objective of checking whether the model could reproduce the effects of subsurface agricultural drainage on stream flows and soil water storage. The model was also used to further our understanding of the impact of soil hydrodynamic properties on watershed hydrology. Flows simulated by CATHY were consistent with traditional subsurface drainage approaches and, for wet years, flows at the outlet of the study watershed corroborated well with observed data. This study demonstrated that CATHY can reliably predict subsurface drainage flow during wet periods; that is the time when it is imperative to know whether a drainage system can meet design criteria. When considering the dynamics of the cumulative storage variation, results showed that the behaviour depended not only on the amount of precipitation but also on the associated distribution throughout the year. When considering surface and subsurface waters, drains reduced exfiltration and surface runoff, and increased infiltration. The more conductive were the soils, the more exfiltration and subsurface drain flows were higher, whereas surface runoff was lower, and for isotropic surface layers, the variations in surface runoff and infiltration were almost equal. Hydrograph separation using simulated results indicated that exfiltration was the most dominant process; peak flows were largely characterized by overland flow; and subsurface drain flow variations were low. These types of studies are needed to build our capacities to manage water resources in agricultural watersheds, where water flow dynamics are often manipulated to increase productivity. A good control of the impact of these manipulations will result in a better understanding of the flows and improved design of management actions to reduce the risks of degrading the quality of surface waters.

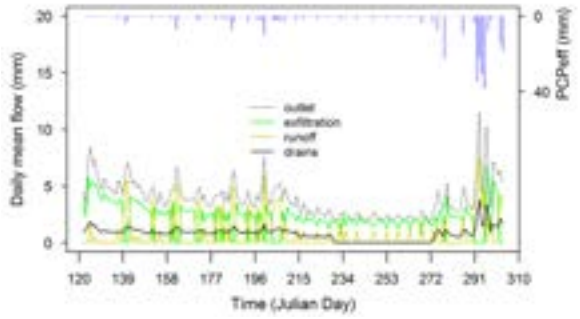

Figure 1: Hydrograph of daily mean flow at the micro-watershed outlet and its different components.

Recent Publications

1. Muma M A N Rousseau and S J Gumiere (2017) Modeling of subsurface agricultural drainage using two hydrological models with different conceptual approaches as well as dimensions and spatial scales. Canadian Water Resources Journal. 42(1):38-53.

2. Assani A, F Delisle, R Landry and M Muma (2015) Effects of land use on flow rate change indices. Forests. 6(11):4349-4359.

3. Muma M, S J Gumiere and A N Rousseau (2014) Global sensitivity analysis of the CATHY model with hydrodynamic soil properties of a drained agricultural micro-catchment. Hydrological Sciences Journal. 59(8):1606-1623.

4. Muma M, S J Gumiere, A N Rousseau, C Scudeler and C Paniconi (2013) Implementation of a root water extraction module in CATHY: comparison of four empirical root-density distribution models. Procedia Environmental Sciences. 19:57-66.

Biography

Mushombe Muma holds a B.A.Sc. Civil Engineering (Université de Moncton, Canada), M.Sc. Civil Engineering (Université Laval, Canada), M.Sc. Environmental Sciences (Université de Québec à Trois-Rivières, Canada), and Ph.D. Water Sciences (Institute National de la Recherche Scientifique, Centre Eau Terre Environnement, Université du Québec). From October 2016, he is an Associate Professor at the Université Nouveaux Horizons in Lubumbashi (Democratic Republic of Congo). He has been a Research Assistant to the Agriculture and Agri-Food Canada project: "Watershed Evaluation of Beneficial Management Practices" from 2009 to 2013. His research works published (more than 12 publications in international scientific journals) or presented at the conferences include the modeling of subsurface agricultural drainage, hydrological model sensibility analysis, effects of the change from forest to agricultural land use among others.

mushombe.muma@ete.inrs.ca

Notes: