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Dynamic Runoff Generation Processes and Models: A Review on Application of Models to Variable Catchment Properties in Ethiopian Highlands

Tadesse Shimels Gebremedhin[1,2], Lutz Breuer[2], Belete Berhanu[1], Solomon Gebreyohannis Gebrehiwot[3]

[1] *Addis Ababa Institute of Technology, School of Civil and Environmental Engineering, Ethiopia*
[2] *Justus-Liebig University Giessen, Inst. for Landscape Ecology and Resources Management (ILR), Germany*
[3] *Addis Ababa University, Ethiopian Institute of Water Resources, Ethiopia*

Abstract

Hydrological models are developed to answer the question how rainfall becomes runoff. Direct runoff could be generated when either rain falls over saturated area (called saturation excess runoff) or the rainfall intensity is greater than the soil infiltration capacity (called infiltration excess runoff). Many of the model's runoff generation processes (RGP) are formulated based on the concept of either infiltration excess or saturation excess. However, RGPs are highly dynamic in space and time, often changing between the two, and hydrological models should account for that. Hence, this paper aims on highlighting challenges and the way forward in developing models with dynamic RGPs. We review the effect of catchment characteristics on RGPs, commonly used models and how they consider RGPs. Our study focuses on the Ethiopian highlands as an example, where RGPs are known to be very heterogonous. The country is characterized with rugged topography with elevation ranging from 120m bsl to 4620m asl. Furthermore, the soil, land use and other RGP controlling factors are highly variable across the country. However, we find that models with one fixed RGP are applied on catchments with different characteristics and known differences in RGPs, whilst several models with diverse RGPs are applied for the same catchment. This kind of random model application leads to structural model uncertainties which likely result in model outputs that might be right for the wrong reasons. Thus, understanding the RGP dynamics and considering this dynamics in the modeling process is needed to get better and more realistic outputs, which are required to appropriate decisions for water management. We present a blue print to overcome this research gap in current hydrological models.

Keywords: Controlling factors, models, RGP dynamism

Contact Address: Tadesse Shimels Gebremedhin, Addis Ababa Institute of Technology, School of Civil and Environmental Engineering, Addis Ababa, Ethiopia, e-mail: asnie2000@gmail.com