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Modelling runoff with a conceptual model based on integration of topographic index in a probability distributed model

L. Liuzzo, L.V. Noto, G. La Loggia

Dipartimento di Ingegneria Idraulica ed Applicazioni Ambientali, University of Palermo (liuzzo@idra.unipa.it / Fax: +39 091 6657749 / Phone: +39 091 6657754)

Hydrological models are an important tool in hydrological processes study and in water resources management. For these reasons, international literature proposes several models that try to reproduce completely and accurately runoff generation phenomena. Currently many researches has focused on identification of relations between geomorphologic properties of a basin and rainfall-runoff processes. In order to understand these relations, a lot of models has been realized, characterized by different structure and level of complexity. Many of these hydrological models make use of morphologic information. TOPMODEL, maybe the most famous of these models, is a semi-distributed, topographically based hydrological model. Starting from its original version, TOPMODEL has been subjected to many modifications, in order to integrate the majority of hydrological processes concerning runoff generation. In this work a conceptual model has been developed to simulate runoff and analyze hydrological processes incorporating topographic information, characteristic of TOPMODEL, in a probability distributed model, or PDM. The class of probability distributed model describes the process of surface runoff generation as the result of soil saturation excess due to precipitation. Soil storage capacity is represented as a variable represented by a probability distribution. This model, here presented, is the result of combination and integration of TOPMODEL with a probability distributed model, and it is indicated with the acronym of TOPDM (TOpography based Probability Distributed Model). TOPDM is based on a schematic representation of the basin, and its lumped parameters was obtained from distributed data. In the model, the topographic index spatial distribution is used to infer storage capacity probability distribution. The relationship between topographic index and storage capacity allows to transform elements

with an high value of topgraphic index (elements placed along the network that have an higher probability of saturation) in element with a low value of storage capacity, and vice versa. As PDMs define, at any point the process of moisture storage can be represented as a simple storage, characterized by a value of capacity c, that can be increased by rainfall and reduced by evaporation. The generation of runoff occurs when precipitation exceeds the storage capacity. The model is based on a simple water balance, in which the components are basin soil moisture storage, precipitation, drainage and evapotranspiration. The model simulates also the vertical drainage to groundwater, that is represented as a storage, characterized by an unlimited capacity. This storage does not exchange water with the sub-surface system, and it generates the slow response of the basin. The model requires the calibration of some parameters, necessaries to evaluate the components of water balance. The model has been applied to the Baron Fork basin with an area of 800 sq.km in Oklahoma, USA. The value of topographic index was derived by the digital elevation model of the basin, using GIS techniques. The precipitation data used in this work has been derived by radar data. TOPDM has been used to reproduce some different flood events and its performance has been assessed by comparison with observed streamflow. The results shows that TOPDM gives a reasonably good estimation of runoff and a realistic representation of physical process in the catchment.