Calibration and validation of a rainfall-runoff model simulating infiltration and saturation excess

Pasquale Versace, Beniamino Sirangelo e Daniela Biondi[1]
Dipartimento di Difesa del Suolo, Università della Calabria, Arcavacata di Rende (CS), Italy

Abstract. A first set of applications of the RISE (Runoff by Infiltration and Saturation Excess) model, performed for a small Southern Italy catchment, the Turbolo Creek basin (29 km2), are described.

The RISE model is a distributed, event-based model, which considers both conceptual and physically-based schemes for the description of small and medium size catchments hydrological response. The model has been designed with a stepwise approach, with the goal of a realistic description of the processes that are assumed to be dominant in controlling storm runoff production and saturated area space-temporal dynamics.

Schematisation of runoff generation on hillslopes describes the interactions between the unsaturated and saturated layer assumed in the soil column of each cell, and allows to compute different contributions to storm runoff: infiltration excess, saturation excess, return flow and subsurface flow. All these local contributions are conceptually routed to the catchment outlet with a Geomorphologic IUH: the adopted approach is based on a rescaled geomorphologic width function, which accounts for the different scales of velocity taking place on hillslopes and stream network.

Eight events were investigated. Model parameters were set as uniform over the entire domain, and were estimated by calibration, with the SCE-UA algorithm, against a single event characterised by a fairly complex shape.

A two step approach was taken in the validation of the RISE model. First a traditional split-sample test was carried out. In the second validation step emphasis was focused on the question of a more general validity and physical soundness of the proposed approach: this task was performed testing the model against hydrological common sense, without the benefit of data.

Several qualitative assessments were considered: ì) evaluation of model ability in reproducing different runoff generation mechanisms; ìì) evaluation of estimated runoff production spatial distribution, and of simulated behaviour of internal variables; ììì) evaluation of model response plausibility for 'virtual' applications representing different hydrological situations.

The results suggest that catchment runoff is mainly produced by saturation excess mechanism, while hortonian overland flow is associated only with high intensity rainfall; the analysis of internal variables behaviour also illustrated model ability to realistically represent the role of different catchment landscape units on storm runoff production.

[1] Dipartimento di Difesa del Suolo
Ponte P. Bucci Cubo 41/b
Università della Calabria
87036, Arcavacata di Rende (CS), Italy
Tel: +39 0984 496618
e-mail: versace@dds.unical.it