
Influence of soil-surface types on the overall runoff of the Tabernas badlands (south-east Spain): field data and model approaches

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Abstract:

The Tabernas desert, an extensive badlands area in Almería province (south-east Spain), is characterized by a high variability in soil surface cover and soil properties along with important topographical contrasts giving rise to a wide range of hydrological behaviour. A double approach through field monitoring and modelling has been used to ascertain the influence of soil-surface variability on the overall hydrological response.

Small plots were monitored for 3 years to assess runoff from the different surface types. Data provided by the long-term monitoring of three small catchments formed by different soil surfaces were used to find out the specific contribution of each soil surface to the catchment runoff.

A simple spatially distributed model was built to predict runoff generation based on the infiltration rate of each soil-surface type (defined as terrain units with the same cover, the same soil type and on the same landform). Plot results prove that the soil surface units within the study area behave differently in terms of hydrological response to natural rainfall. These responses are explained by the types of cover, topographical characteristics and soil properties. When runoff events are *simple* (with one or two runoff peaks), the modelled hydrographs reproduce the hydrographs observed reasonably well, but in *complex* events (with several runoff peaks) the adjustment is not as good. The model also shows the influence of the spatial distribution of soil surfaces on the overall runoff, aiding exploration of the spatial hydrological relationships among different landscape units. Copyright © 2002 John Wiley & Sons, Ltd.

KEY WORDS runoff; Hortonian infiltration; overland flow; badlands; soil-surface conditions; spatially distributed model; Tabernas

INTRODUCTION

Topography, soil characteristics, vegetation and climate interact in a complex manner determining the type, intensity, and location of runoff production and the transport of sediments in a landscape (Wigmosta *et al.*, 1994). Recent studies on hillslope hydrology in semi-arid and arid areas show that the spatial generation of runoff is strongly non-uniform, and quite often only a small proportion of the area of small watersheds contributes to the main channel as storm runoff. This spatial non-uniformity in runoff generation is related to the wide spatial variation in infiltration capacity, which depends mainly on the physical and chemical properties of the surface material. Numerous studies (Morin and Benyamini, 1977; Bryan *et al.*, 1978; Yair *et al.*, 1980; Campbell, 1982; Hoogmoed and Stroosnijder, 1984; Yair and Lavee, 1985; Berndtsson and Larson, 1987; Alexander and Calvo, 1990; Wilcox *et al.*, 1990; Yair, 1990; Calvo *et al.*, 1991; Casenave and Valentin 1992; Bromley *et al.*, 1997; Solé-Benet *et al.*, 1997) have shown that apart from rainfall characteristics, surface conditions, such as soil crusting, rock pavement, plant cover and geomorphological position, play a major role in runoff production.

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