

Runoff generation in a Mediterranean semi-arid landscape: Thresholds, scale, rainfall and catchment characteristics

Fabian Ries (1,2), Sebastian Schmidt (2), Martin Sauter (2), and Jens Lange (1)

(1) Hydrology, Faculty of Environment and Natural Resources, University of Freiburg, Freiburg, Germany (fabian.ries@hydrology.uni-freiburg.de), (2) Applied Geology, Geoscience Center, University of Göttingen, Göttingen, Germany

Surface runoff acts as an integrated response of catchment characteristics and hydrological processes. In the Eastern Mediterranean region, a lack of runoff data has hindered a better understanding of runoff generation processes on the catchment scale, despite the importance of surface runoff as a water resource or flood hazard. Our main aim was to identify and explain differences in catchment runoff reactions across a variety of scales.

Over a period of five years, we observed runoff in ephemeral streams of seven watersheds with sizes between 3 and 129 km². Landuse and surface cover types (share of vegetation, bare soil and rock outcrops) were derived from aerial images by objective classification techniques. Using data from a dense rainfall network we analysed the effects of scale, catchment properties and aridity on runoff generation. Thereby we extracted rainfall and corresponding runoff events from our time-series to calculate event based rainfall characteristics and catchment runoff coefficients. Soil moisture observations provided additional information on antecedent moisture conditions, infiltration characteristics and the evolution of saturated areas.

In contrast to the prevailing opinion that the proportion of Hortonian overland flow increases with aridity, we found that in our area the largest share (> 95 %) of runoff is generated by saturation excess overland flow in response to long lasting, rainfall events of high amount. This was supported by a strong correlation between event runoff and precipitation totals. Similar rainfall thresholds (50 mm) for runoff generation were observed in all investigated catchments. No scale effects on runoff coefficients were found; instead we identified up to three-fold runoff coefficients in catchments with larger extension of arid areas, higher percentage of rock outcrops and urbanization. Comparing two headwater catchments with noticeable differences in extent of olive orchards, no difference in runoff generation was detected. Besides rainfall characteristics, we found that available soil water storage capacity and bedrock permeability are the most important factors controlling runoff generation in our study area.