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"Partial area contribution" and "Overland flow discontinuity": from humid to arid hillslopes

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In humid temperate areas, where infiltration rate and soil moisture are high the hillslopes are draining mainly via shallow subsurface flow. Overland flow is seldom generated on the very low parts of hillslopes when the soil is saturated up to the surface. This spatial pattern is known as “partial area contribution”.

In contrary, in arid areas, where the soil moisture is hygroscopic most of the time, overland flow is generated not because of soil saturation conditions but only when rainfall intensity is higher than the infiltration rate.

Nevertheless, we found a “partial area contribution” pattern in several arid and semi-arid areas due other controlling factors:

- In eastern Sinai, under rainfall simulation experiments on scree slopes, due to high spatial differences in the soil texture, runoff coefficient in the gullies was almost 100% while in the very permeable interfluves runoff wasn’t generated at all. Overland flow was generated, therefore, only in the gullies (Lavee ,1973; Yair & Lavee ,1976).
- In an instrumented experimental watershed in the Northern Negev, the specific overland flow yield from long plots ,extending from the divide to the slope base (around 60m in length), was consistently lower than the combined specific overland flow yield from the adjacent two short plots (around 30m in length), draining the upper and the lower sections of the hillslope, respectively. This means that the overland flow is discontinuous and at least part of the overland flow that was generated at the upper part of the hillslope infiltrated, in most overland flow events, into the soil, before reaching the slope base. In other words, only the lower part of the hillslope contributes, in most cases, overland flow to the channel. Such overland flow discontinuity is controlled by: 1. The typical short duration of rain showers in arid areas. As more than 80% of the rain showers last for less than 15 minutes, the total flow duration is usually shorter than the concentration time. 2. The spatial distribution of infiltration rate. In this case it was mainly the relatively high infiltration rate in the colluvial cover at the lower part of the hillslopes in part of the study area that absorbed large amount of the water flowing from the upper part of the hillslopes (Lavee, 1982; Yair & Lavee, 1985; Lavee & Yair, 1990).
- In an experimental project along a climatological transect, running from the Mediterranean climate near Jerusalem to the extreme arid climate near the Dead Sea, the main reason for the

overland flow discontinuity, especially in the semi-arid area, was the mosaic pattern of “source patches”, on which overland flow was generated, and “sink patches”, in which at least part of the direct rain and the incoming overland flow infiltrated. This pattern is produced by different processes, mainly via the effect of vegetation, but also due to the effects of micro-topography, big stones, especially if they are partly embedded in the soil, and livestock grazing (Lavee & Poesen, 1991; Lavee et al., 1998; Stavi et al., 2008).