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Monitoring hillslope subsurface stormflow and overland flow initiation in an experimental catchment of South Italy

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Hillslopes represent basic landscape elements of the catchment hydrological global response. Understanding hillslope subsurface and overland flow response to rainfall events is of primary interest when managing land and water resources at catchment scale, as they represent key processes controlling water, sediments and pollutants transport. Experimental data concerning the hydrological conditions leading to the initiation of hillslope lateral subsurface response are quite rare, particularly in Mediterranean catchments, characterised by a strong climatic seasonality. In this study the results of an intensive field campaign conducted in a small experimental catchment (5 ha) of South Italy are illustrated. The catchment soil is essentially composed by a 60 cm clay loam uppermost horizon, with significant vertic features, roots and macropores, overlying a deep clay C-horizon. Field and laboratory tests revealed that the hydraulic conductivity of the top horizon is dominated by lateral preferential flow paths through the top soil macropores, while the bottom C-horizon behaves almost as an impervious layer. Surface soil moisture patterns have been observed by spots observations according to a regular 25-m grid across the catchment, every two-three weeks across approximately one year and half. Subsurface storm flow has been monitored by 3 water harvesting wells, with a depth of 3 m and draining hillslopes with a spatial extent ranging from 0.2 ha to 1 ha. Flow at the catchment outlet has been observed by a V-notch weir, while climatic data have been provided by a local automatic weather station. The overall data gathered during this period show that the hillslope

hydrologic response evolves mainly through four dominant stages as follows: a dry stage, when no lateral flow is observed during rainfall events; a dry-to-wet and a wet-to-dry transition stages, when only subsurface flow is observed; and then a wet stage, when both subsurface and saturated overland flow is observed. Subsurface storm flow response is clearly distinguishable during the transition stages, with characteristic response time of two to three hours. Soil moisture patterns exhibit specific statistical properties within each of the mentioned stages. Soil moisture frequency distributions are negatively skewed during the wet stage and positively skewed during the dry stage, while following a bimodal shape in the transition stages, because of preferential lateral flow as the subsurface storm flow is triggered.