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Different approaches to investigate flood generating mechanisms in the low mountain range basin Frankelbach

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Floods with a return period higher than about 30 years are rarely recorded in discharge time series of meso-scale basins and hardly ever in field observations. Thus, there are only very few field observations of runoff generation processes during high or even extreme precipitation. The last decades various perceptions have been presented in the literature concerning the crucial processes and contributing areas that effect the peak flow: piston flow or saturation overland flow in the riparian zone, preferential flow pathways that lead subsurface flow rapidly to the stream, impervious areas such as urban areas, roads, skidder trails, hydrophobic surfaces or frozen soils that generate infiltration excess overland flow, flow accumulation at convergent slopes and consequently the expansion of the stream network during wet conditions.

In the research basin Frankelbach (Rhineland-Palatinate, Germany) hydrological observations have been carried out since autumn 2004 aiming to investigate flood generation and erosion processes, as well as to assess the effectivity of flood retention measures (afforestation, transformation of forest roads, small retention reservoirs). The low mountain range basin of 5 km^2 with underlying Rotliegend-sediments shows agriculturally used highlands, steep forested v-shaped valleys and a narrow floodplain in the lowest region. The small village Frankelbach covers less than 5% of the area and has been damaged by floods in the 1990th.

Data has been collected both continuously (discharge and water temperature of four nested basins, climate data, soil moisture with TDR-approach) and during single

floods (suspended sediments, major cations and anions). During an extensive measurement campaign infiltration and sprinkling experiments (40 mm/h rainfall, plot area 0.28 m^2) have been carried out. Thus, the infiltration rate, the runoff coefficient, the ponding time and the sediment load could be determined for 12 plots of different slope, landuse and management. The highest runoff coefficients and lowest infiltration rates were found in coniferous forest due to the hydrophobic needles and on bare not mulched fields due to siltation of the surface.

The present study focuses on the question which data, measurements and analysis methods are suitable to progress in understanding of the predominant processes during very wet conditions even if one is not able to observe high floods? Up to now, in the Frankelbach basin the captured floods were only of lower magnitude. Therefore, the results of the plot-scale sprinkling experiments were combined with findings of field surveys, delineations of hydrological response units and GIS-analyses. Furthermore simple hydraulic and GIS-based calculations were used aiming to quantify the peak flow and flood volume for different scenarios of flood generation.