Hydrological modelling from the plot to the catchment scales in a tropical cultivated area

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An important issue in spatially distributed modelling is parameterisation and calibration strategies from the local measure to the plot and the catchment scales. In cultivated areas, hydrological processes are mainly controlled by the geometry of surface flow pathways (ditches, tracks, etc.), the tillage practices and the vegetation pattern which modify rainfall interception. Soil properties are measured at the local scale and then extrapolated to the basin scale. However, few studies take into account the role of tropical vegetation on rainfall/runoff processes across scales. This paper aims to characterize the role of banana (Musa spp.) cover in tropical region on runoff processes across scales and to assess at the catchment scale the runoff contributing areas. Three sites, located in Guadeloupe (FWI), Lesser Antilles are planted with banana and monitored for runoff and piezometric measurements since year 2001: plot A (3 000 m^2), plot B (2 400 m^2) which is included in the C catchment (17.8 ha; 55% banana, 40% fallow land, and 5% tracks and sheds). The experimental sites are characterized by abundant rainfall (4230 mm/year) and a high water infiltration capacity on andisols (saturated hydraulic conductivity, Ks of 30 to 75 mm/h). The spatially distributed model MHYDAS, which considers a catchment as a series of interconnected fields units linked to the ditch network, was used at the storm event timescale. At the banana tree scale, since rainfall is intercepted and concentrated at its base via stemflow, we developed a rainfall redistribution function which takes into account the increase of rainfall intensity on the furrow. First, MHYDAS parameters were calibrated at the A plot scale on 20 events. Then, the calibrated parameters were spatially distributed at the catchment scale. Finally, for validation, MHYDAS was used to simulate runoff and

piezometric levels at the B plot and the C catchment scales on 30 events with different spatial partitioning of landscape, e.g. from a global approach (one unit) to a distributed approach (n units). The results show, at the plot scale, a high vegetation influence on surface runoff simulation generated by stemflow processes and a production of runoff for smaller rainfall intensities than the Ks measured on the field. At the catchment scale, the influence of vegetation pattern is globally lower and decreases with an increase of the variability of fields units used in the spatially distributed model. In fact, spatially distributed model allows re-infiltration and drainage in fields and ditches and generates a smoothed response of the basin. Globally, results highlight the cropping influence on runoff coefficient across scales and allow progress in identifying modelling strategies for cultivated areas.