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The Effects of Land Use and Soil Cover Changes on Soil Hydrology in Southeastern Brazil

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Land-use and soil cover changes tend to generate a variety of modifications in the upper portions of the soil profile that usually lead to a decrease in infiltration rates and to an increase in overland flow and soil erosion. Such a scenario has been noticed in many areas of southeastern Brazil, especially those located in the hilly topography of the Serra do Mar in Rio de Janeiro state, where the native rain forest has been gradually replaced by farming activities. In this study, based both on field experiments and soil water monitoring inside an experimental basin, we focused on defining the effects that recent land use and soil cover changes, induced by the expansion of farming and urbanization, generated on soil-water storage capacity. Inside the Bonfim experimental basin (25 km2) the following land use and soil cover classes have been observed: natural rain forest (upper portions), regenerated forest (between 15 and 40 years old), agriculture, grazing, as well as urbanized areas in the lower portions. This basin is typical of the hilly topography of Serra do Mar including steep hillslopes with shallow soils developed on gneisses and granite and high total annual rainfall values (about 2300 mm). Soil-water potential (SWP) was monitored using automatic Watermark sensors installed at different depths (10, 20, 50 and 80 cm) in the main classes of land use and/or soil cover. In parallel, undisturbed soil samples were collected at these depths to characterize the main soil physical properties at each monitored site. Three automatic rain gauges were also installed in the upper, mid and lower portions of the basin. The results suggest that areas under grazing present the highest soil-water storage values, while the smallest ones were observed in areas under forest. Besides vegetation, soil properties also play a major role in controlling such response since soils under grazing have higher clay and bulk density values than the ones under forest. While the upper portions of the soil profile under grazing are able to respond to rainfall events smaller than 20 mm, there is a lag of 2 days for saturation to be attained at lower depths (> 50 cm). Such a lag was not observed in forested areas for rainfall events greater than 40 mm, and the whole monitored soil profile attains saturation basically at the same time, suggesting intense vertical soil-water movement. Areas under agriculture, on their turn, present an intermediary behavior. The results, although preliminary, attest the role played by land use and land cover changes in controlling soil hydrological response in this environment.