

Spatiotemporal suspended sediment dynamics within a peri-urban Mediterranean catchment

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Erosion is one of the main soil concerns identified by the European Commission. In peri-urban areas, soil erosion can often be enhanced by a variety of human activities, such as urbanization, inadequate agricultural practices and disturbances in forest environments. These disturbances can link to distinct sediment fluxes with detrimental impacts on aquatic ecosystems. This may be of particular relevance in the Mediterranean region, where relatively infrequent but intense storms affect sediment dynamics within catchments. This study investigates spatiotemporal suspended sediment dynamics in a small (615 ha) peri-urban catchment (Ribeira dos Covões) in central Portugal during an urbanization stage and a subsequent period of relative land-use stability. The catchment has undergone significant urbanization over the last few decades, culminating between 2009 and 2012 in major land-use changes associated with the construction of an enterprise park and a major road, covering 5% and 1% of the catchment area, respectively. After this period, an economic crisis put a brake on urbanization and the land-use remained relatively at 40% urban, 56% woodland and 4% agriculture. Spatiotemporal patterns of suspended sediment dynamics were assessed via water sampling in (i) 10 storms between October 2011 and March 2013, during construction works, and (ii) 10 storms between November 2017 and November 2018 during the subsequent period of land-use stability. In each storm, samples were collected over the hydrograph at four sites at the catchment outlet; and in 3 upstream sub-catchments. The latter comprised: (i) Quinta (141ha), 67% woodland, 25% urban (including the enterprise park) and 8% agriculture; (ii) Espírito Santo (54ha), 49% woodland, 46% urban and 5% agriculture; and (iii) Porto Bordalo (52ha), 55% woodland, 42% urban and 3% agriculture. Quinta recorded a significant decline in suspended sediment concentrations from the urbanization stage (up to 4320mg/l) to the stable land-use period (up to 335mg/l). This appears to be linked primarily to 5 years of vegetation recovery in the unpaved parts of the enterprise park. In the other sub-catchments, unaffected by the urbanization stage, Porto Bordalo displayed higher suspended sediments than Espírito Santo during in the 2011-2013 storms, possibly due to piping of urban runoff to the stream, whereas in Espírito Santo runoff from paved surfaces is dispersed in surrounding downslope areas of pervious soil. In 2018, however, highest suspended sediment concentrations were recorded in Espírito Santo (up to 1033mg/l) due to forest clear-felling close to the stream network. At the catchment outlet, maximum suspended sediment concentrations decreased from 1656mg/l to 810mg/l, from the urbanization to the stable land-use periods. Understanding spatiotemporal sediment dynamics and how they are influenced by land-uses and their spatial pattern within peri-urban catchments is important to support management activities to mitigate land degradation and ensure the good status of the downstream aquatic ecosystems.