Sediment dynamics in a small peri-urban catchment

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Soil degradation is a global concern that impairs some of the sustainable development goals. The identification of sediment sources and understanding of sediment dynamics is relevant to support sustainable management, particularly in landscapes with complex land-use mosaics, characteristic of peri-urban catchments. This study aims to assess spatial and temporal dynamics of fluvial sediments and identify the main sediment sources in a small typical peri-urban catchment. The study was performed in Ribeira dos Covões catchment (6.2 km2), in central Portugal, under humid Mediterranean climate. The catchment has contrasting lithology, including sandstone (56%) and limestone (41%) units, as well as alluvial deposits (3%) in the main valleys. The land-use comprises 56% of woodland, 40% urban, including mainly residential areas but also an enterprise park and a major national road (covering 5% and 1% of the catchment, respectively), and 4% of agricultural fields. The study uses a multiproxy sediment fingerprinting approach, based on elemental geochemical characterization of fluvial sediment and soil samples, performed through x-ray fluorescence analysis. Thirty three composite fluvial sediment samples were taken within the stream network (including tributaries and downstream sites). These samples were collected in two contrasting periods during 2018: July, in order to sample sediments transported latter in the wet season; and November, after a large storm recorded at the end of the dry season. Composite samples of potential sediment sources were collected in July and included (i) 64 soil surface (0-2cm) samples taken over the catchment, (ii) 17 samples from eroding channel margins, and (iii) 15 samples of road sediments, accumulated in gutters. Sediment sources were collected only once due to their relatively stable chemical composition. A range of statistical techniques, including hierarchical cluster analysis, was used to identify discriminant sediment properties and similarities between fluvial sediments and sediment sources of distinct particle sizes (<63μm, 63-125μm, 125-250 μm and 250-2000μm).
Lithology plays an important role on the geochemical signatures of the samples. The enterprise park, embracing a wide area of soil barely covered by vegetation, is the major sediment source within the catchment. Small forest areas clear-felled near the stream network during the spring, represent a significant source of sediments in July sampling, but not in November, indicating a quick exhaustion of sediments ready available. Sediments mobilized from paved roads comprise a relevant source of sediments in sub-catchments with larger urban areas, particularly due to high heavy metal concentrations. The contribution of distinct sources of sediments reaching the catchment outlet slightly changes for distinct particle sizes investigated. Sediment fingerprinting is a promising approach to identify the main sources of sediments, necessary to support management strategies in peri-urban catchments.