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Urban areas impact on surface water quality during rainfall events

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Increasing population and welfare puts water management under stress, especially in what concerns water quality. Surface water properties are strongly linked with hydrological processes and are affected by stream flow variability. Changes in some chemical substances concentrations can be ascribed to different water sources. Runoff generated in urban areas is considered the main responsible for water quality degradation inside catchments.
This poster presents the methodology and first results of a study that is being developed to assess the impact of urbanization on surface water quality, during rainfall events. It focuses on the Ribeira dos Covões catchment (620 ha) located in central Portugal. Due to its proximity to the Coimbra city in central region, the urban areas sprawled during the last decades. In 2008, urban areas represented 32% of the area. Recently a highway was constructed crossing the catchment and a technological industrial park is being build-up in the headwaters.
Several water samples were collected at four different locations: the catchment outlet and in three sub-catchments with distinct urbanization patterns – Espírito Santo that represents a highly urbanized area (45%) located over sandstone, Porto do Bordalo with 30% of urbanized area located over limestone, and IParque, mainly forest and just downstream the disturbed technological industrial park construction area. The samples were collected at different times during rainfall events to monitor the variability along the hydrograph. Six monitoring campaigns were performed: two in April 2011, at the end of the winter period, and the others between October and November 2011, after the dry summer. The number of samples collected per monitoring campaign is variable according with rainfall pattern. Parameters such as pH, conductivity, turbidity and total suspended sediments were immediately analyzed. The samples were then preserved, after filtered (0.45μm), and later analyzed for dissolved chemical oxygen demand, total phosphorous, nitrogen (Kjeldahl, nitrate and ammonium), some cations and heavy metals, according with standard methods. In each monitored location there is a continuous-recording water-level that provides flow data. The rainfall data is monitored with a raingauge located at the catchment outlet.
The results show that surface runoff affects stream water quality according with rainfall pattern. During rainfall events the rising limb flow is associated with an increase in suspended sediment concentration and turbidity, particularly at Iparque. In this sub-catchment, the deforestation and the topsoil removal associated with the technological industrial park construction, promotes suspended sediments growth ranging from 395% to 1645%, corresponding to peak concentrations of 1049mg/L and 3621mg/L, for similar rainfall amounts but with distinct intensities (0.4mm/5minutes and 1.2mm/5minutes, respectively). As regards to the monitored dissolved chemical properties, despite the variability, related with the hydrograph, the increase is much lower comparing with the suspended sediments. Generally, the values are higher at the catchment outlet, which can indicate that the contact time between rainfall and the surfaces before reach the water line affects water quality. This should be considered during urban planning to improve water quality and reduce environmental impacts with low investment.