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Hydrological changes in a Mediterranean urbanizing catchment

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Planning of new urban developments impact the hydrologic regime adversely and may lead to flooding downstream. Current planning methods are based on standard engineering guidelines that might not be optimum for a watershed. The aim of this study is to assess urban design methods and to identify alternative practices that minimize the impact on the hydrological cycle. To meet this objective, the hydrology of a small 6 km2 urbanizing Mediterranean watershed called Ribeira dos Covões is being monitored. This catchment, located in central Portugal, is rapidly urbanizing.

Since 2005, the catchment hydrological response has been monitored, through a continuous-recording network that includes a weather station and a river water-level recorder at the outlet. In autumn 2010 the monitoring network was extended by six additional rain gauges and eleven water-level recorders. In addition, to improve understanding of rainfall-runoff relationships, nine runoff plots (16m2) were installed in the forest areas.

The results revealed a high spatiotemporal variability in soil hydrological properties. During dry summer period, water repellence in forest areas was dominant, promoting Hortonian surface runoff. Nonetheless, despite extreme soil hydrophobicity the greatest runoff coefficient measured in the runoff plots was only 2.5%, indicating that most rainfall moved via the subsurface to the regional groundwater. During wet periods, hydrophobicity breaks down, and surface runoff is produced in saturated areas located mainly in low flat areas where the regional groundwater intersect with the surface.

Despite the enlargement of the urban areas from 20% to 32% in the last 10 years, the catchment annual runoff coefficient has remained relatively small, and was below 16% even for the largest storm of 29mm/day on record in 2010. The annual percentage ranged between 7% and 12% between 2008 and 2010. The current low runoff coefficients area a result of the generally sandy soils, the limestone geology (in part of the area) and the deep filled Valley on which the watershed is located. All those factors promote infiltration and flow of groundwater under the gage. Nonetheless, the catchment has a quick hydrological response, from the relatively small saturated and water repellent areas, and possibly the urban drainage system.

Considering the quick hydrological response and the predictable runoff increase, associated with urban areas expansion, it is expected flood risk to increase significantly. For this reason it is important to implement planning strategies to preserve the existent infiltration areas and promote new ones.