Effect of the Resolution and Accuracy of DTM produced with Aerial Photogrammetry and Terrestrial Laser Scanning on Slope- and Catchment-scale Erosion Assessment in a Recently Burnt Forest Area: a Case Study

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Wildfires are a common phenomenon in Portugal, affecting on average 100.000 ha of rural areas per year and up to 400.000 ha in dramatic years like 2003 and 2005. Wildfires can strongly enhance the hydrological response and associated sediment losses in recently burnt forest catchments and, thereby, negatively affect land-use sustainability of the affected terrains as well as ecosystem functioning of downstream aquatic habitats. Therefore, the EROSFIRE-I and –II projects aim at developing a GIS-tool for predicting soil erosion hazard following wildfire and, ultimately, for assessing the implications of alternative post-fire land management practices.

Assessment of runoff and soil erosion rates critically depends on accurate estimates of the corresponding runoff areas. In the case of catchments as well as unbounded erosion plots (arguably, the only practical solution for slope-scale measurements), delineation of runoff area requires a Digital Terrain Model (DTM) with an adequate resolution and accuracy. The DTM that was available for the Colmeal study area, localized in the mountain range of Lousã, in the central part of Portugal, of EROSFIRE-II project is that of the 1:25.000 topographic map produced by the Military Geographic Institute. Since the Colmeal area involves a rather small experimental catchment of roughly 10 ha and relatively short study slopes of less than 100 m long, two different data acquisition techniques were used to produce high-resolution and high-accuracy DTM. One of the data acquisition techniques is aerial photogrammetry whilst the other is terrestrial laser scanning. In order to produce a DTM by photogrammetric means, a dedicated digital aerial photography mission was carried out. The images have a pixel size of 10 cm. Manual measurements permitted to measure breaklines and were complemented by automatic measurements. In this way, a DTM in a TIN format was produced. This was further converted to grid format using the ArcGIS software system. Signalized control points allowed obtaining the DTM in the same global reference system as that employed for terrestrial laser scanning. The terrestrial laser scanning was done using a Riegl LMS Z360I, stationed in 8 points within the area to provide a complete coverage. The resulting dense cloud of points was filtered – by the company carrying out the scanning mission - to remove the non-terrain points (in particular vegetation). Several grids of different sizes were produced (0.10 x 0.10, 0.20 x 0.20, 0.50 x 0.50, 1 x 1 and 2 x 2 m2).

This work will study the effect on runoff and erosion rates at the slope- and catchment-scale of DTM with different resolution, but produced with data collected with the same acquisition technique, and of DTM with the same resolution, but produced with data collected with the two different acquisition techniques.

The study is being carried out in ArcGIS using DTM in a grid format. Preliminary results suggest that the conversion of TIN-to-grid in ArcGIS produces results that depend on the procedure being applied. Therefore, the different algorithms available at ArcGIS for TIN-to-grid conversion are currently being tested, using an artificially produced DTM. This testing includes various interpolation techniques for grid generation, and will be extended to different algorithms for computation of drainage flow direction.