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# Overland flow (dis)connectivity in a new vineyard under steep slope conditions in the Spanish Pyrenees: Effect of DEM resolution and terrain preparation

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The ability of identifying –based on numerical analysis– disconnected areas –in terms of overland flow pathways– depends on the digital elevation model (DEM) resolution, type of flow accumulation algorithm and DEM accuracy. On the other hand, tillage practices (in lowlands) and terrain preparation (at any slope gradient) may condition the occurrence of permanent/ temporal disconnected areas. In this study, the effect of DEM resolution and the presence of a drainage ditch and forest trails on the number, location and characteristics of disconnected areas is evaluated in a steep (mean slope gradient of 29%) farmland area of the Spanish Pyrenees. A new vineyard plantation (3785 $m^2$ and 5120 $m^2$ including the transit area; espalier system) and its upslope drainage area are evaluated. This site is located near Barbenuta village (Huesca province), at high elevation (1184-1260 m a.s.l.). Abandoned terraced fields and patches of natural vegetation (trees and shrubs) occupy the upslope area, where several forest trails cross from east to west. To protect soil against water soil erosion, farmers built a drainage ditch (total length of 137 m; ca. 0.30 m width; ca. 0.15 m depth) upslope the vineyard boundary, which minimizes runoff entrance into the field. A professional drone (senseFly© eBee X) was used to obtain –after point cloud processing– Structure-from-Motion (SfM)-derived DEMs at different spatial resolution, namely: 1, 0.5, 0.2, 0.1 and 0.05 m. We used combined information of the DEMs before and after filling the local sinks. As expected, the number (n=34, 341, 1079, 1272 and 1907) and size (mean=500, 60, 21, 18 and 12 $m^2$; median=68, 15, 5, 4 and 2 $m^2$; σ=920, 178, 69, 71 and 49 $m^2$) of sub-basins increased and decreased, respectively, with decreasing the pixel size, due to fractal geometry and higher influence of micro-topography components (e.g. soil roughness, random local sinks) –higher ratios of 'residual topography (σ of slope) / pixel size': 0.2 (at coarser resolution), 1.8, 20.3, 113.6 and 636.8 (at finer resolution)–. The total area also varied with the different DEMs: 17010, 20514,

22398, 22852 and 22807 $m^2$. The number (n=21, 292, 903, 928 and 1283) and area (41, 143, 118, 58 and 44 $m^2$) of disconnected areas increased and decreased, respectively, with decreasing the pixel size, representing 0.24%, 0.70%, 0.53%, 0.25% and 0.19% of the total drainage area. Similar differences were observed in other topographic metrics like the drainage-boundary perimeter and maximum flow length. These results prove the impossibility of defining a unique overland flow pattern. Further research should be focused on the role of runoff depth and how the effect of man-made landscape elements (drainage ditch, forest trail) and practices (tillage) on disconnectivity may depend on rainfall depth and intensity, and indirectly on plant growth.