

An approach to identification and modelling of artificial grounds in urban area from multidisciplinary data (Oviedo, NW Spain)

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This contribution describes the investigation of changes on urban relief caused by anthropogenic processes in Oviedo (population 215,000), the capital city of Asturias, formerly a Christian kingdom (719-925 AD) located in the north-western Iberian Peninsula. This city is placed on a Mesozoic-Cenozoic basin above a folded Paleozoic basement. Oviedo's subsurface is formed by carbonate and siliciclastic Cretaceous formations, and the overlying fluvial-lacustrine deposits of Paleogene age; the latter are mainly composed of marls, clays and gypsum layers. The urban core, which extends 15 km², presents an elevation range between 160 to 330 m above mean sea level and the natural slopes reach up 15° in the built-up area.

The research involved at first the collection and review of more than 950 borehole logs, presenting the man-made fills an average thickness of 1.9 m with maximum value of 25 m. Then topographic variations that occurred during the period of greatest urban development were analysed through map algebra. The data used to construct Digital Elevation Models (DEM) were provided by 1:5,000 city maps performed since 1869 to the present, all properly georeferenced. The subtraction operations generated Digital Terrain Models representing ground elevation gains and losses during different periods of time, after setting the necessary control points (elevation remains invariant) and corrections in order to avoid altitude deviations between DEMs. The thicknesses estimated for the man-made fills were compared with borehole data to validate the prediction, obtaining good correlations. The GIS-based methodology was complemented by an inspection of the historical evolution of land uses (i.e., using ancient street maps, aerial images interpretation and documentary references since the thirteenth century), and the analysis of all the surficial geological maps that have been published. Man-made grounds were then classified into categories, mainly: (i) earthworks related to urban development; (ii) ground modified by civil engineering; (iii) ground modified by quarrying activities; (iv) dumping sites. Further modified landscapes were studied using more detailed DEMs (up to 1x1 m cell size) to generate isolines maps indicating excavated and filled areas.

This research provided valuable information about the distribution, geometry, volume and origin of the main accumulations of man-made fills and excavated areas. Especially noteworthy was the study of topographic changes caused by fills and excavations related to old quarries (extracting limestone, sand and clay). These quarries, abandoned for hundreds of years, are now hardly recognizable due to the growth of the city but have great historical significance. In fact they supplied building stone for some monuments of Oviedo and the Kingdom of Asturias that are included in the World Heritage List of Unesco.