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Quantitative Mapping of 3-Dimensional Land Surface Elevation Changes in Washington D.C.

The need for flat tracts of land appropriate for urban development led to the leveling of hills and filling of marshes, stream valleys, and creek bottoms throughout many cities at the turn of the century. The cumulative effect of “cut-and-fill” activities throughout a city’s lifecycle has drastically modified the topographic land surface and resulting urban geomorphology, hydrology, and ecology. The capability to map historical changes in land surface elevation addresses many questions related to landscape change analysis in urban environments. The objective of the presented research was to map and quantify 3-dimensional land surface elevation changes in Washington D.C. from the late 1800s to the present. This research presents a rigorous methodology to map elevation change utilizing geographic information systems (GIS), historical maps, and digital elevation model (DEM) processing. Methodological error calculations were performed using high accuracy global positioning system (GPS) measurements and geologic drill-hole records. The resulting elevation change maps reveal areas underlain by up to 18 meters of fill, as well as hill slopes which have been subjected to an equivalent amount of modification in a unique spatial pattern throughout the study area. Additionally, landscape features previously thought to be geologic terraces were found to be man-made. Quantitative measurements of pre- and post-modification terrain parameters, such as slope, aspect and curvature are presented to further define geomorphologic changes and to assist in understanding the effect urbanization may have on watersheds, stream discharge, and the development of urban soils and surficial geology.