# Evaluating Digital Elevation Models: A Comparison of Terrestrial, UAV, Satellite, and Airborne Sources in District Six, Cape Town

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**SUMMARY**

This paper evaluates the accuracy and resolution of Digital Elevation Models (DEMs) generated from Unmanned Aerial Vehicles (UAVs) in comparison to traditional terrestrial, satellite, and airborne sources within the context of District Six area in Cape Town, South Africa. Known for its rich historical significance and complex urban landscape, District Six presents a compelling case for analysing various DEM generation methods. The primary objective of this paper is to assess the applicability of UAV-generated DEMs for urban planning and heritage conservation, in areas that demand high-resolution and accurate elevation data. This study utilized UAV technology to create high-resolution DEMs, capturing detailed elevation data with resolutions ranging from 5 to 20 centimeters. This fine level of detail allows for precise urban features and topography analysis. A DEM generated from a Total Station is a 3D representation of terrain elevation based on precise measurements taken with the instrument. A Total Station typically offers high resolutions because it captures precise point measurements at specific locations, allowing for dense point spacing and a more accurate representation of the terrain. The Total Station captures the horizontal distance and vertical angle to calculate the exact 3D coordinates of each point. These coordinates are then used to create a DEM, which visually represents the elevation changes across a landscape. The DEM generated from a Total Station is useful for applications in many various fields requiring detailed topographic data. Conversely, satellite-based DEMs, such as those derived from the Shuttle Radar Topography Mission (SRTM), typically provide lower resolutions, often between 10 and 30 meters. These satellite models face challenges in urban environments due to building obstructions and vegetation, which can significantly affect elevation accuracy. Airborne LiDAR was also incorporated into the analysis, offering moderate resolution and accuracy at a higher operational cost. While airborne methods provide valuable data, they do not match the spatial resolution achieved by UAVs for localized studies. Ground control points were employed to assess the accuracy of each DEM type, revealing that UAV-generated models significantly outperformed their satellite and airborne counterparts, with a Root Mean Square Error (RMSE) of less than 8 cm. The findings underscore the advantages of UAV technology for generating detailed topographical maps in urban settings. The ability to capture high-resolution data rapidly and cost-effectively positions UAVs as a vital tool for urban planners and heritage managers. This research suggests that integrating UAV-derived DEMs with existing datasets can enhance decision-making processes and contribute to the preservation of culturally significant areas like District Six.