Quality of terrestrial data derived from UAV photogrammetry: a case study of the Hetao irrigation district in northern China

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Most crops in northern China are irrigated, but the topography affects water use, soil erosion, runoff and yields,. Technologies for collecting high-resolution topographic data are essential for adequately assessing these effects. Ground surveys and techniques of light detection and ranging have good accuracy, but data acquisition can be time-consuming and expensive for large catchments. Recent rapid technological development has provided new, flexible, high-resolution methods for collecting topographic data, such as photogrammetry using unmanned aerial vehicles (UAVs). The accuracy of UAV photogrammetry for generating high-resolution digital elevation models (DEMs) and for determining the width of irrigation channels, however, has not been assessed. We used a fixed-wing UAV for collecting high-resolution (0.15 m) topographic data for the Hetao irrigation district, the third largest irrigation district in China. We surveyed 112 ground checkpoints (GCPs) using a real-time kinematic global positioning system to evaluate the accuracy of the DEMs and channel widths. A comparison of manually measured channel widths with the widths derived from the DEMs indicated that the DEM-derived widths had vertical and horizontal root mean square errors of 13.0 and 7.9 cm, respectively. UAV photogrammetric data can thus be used for land surveying, digital mapping, calculating channel capacity, monitoring crops, and predicting yields, with the advantages of economy, speed, and ease.