An Assessment of Airborne LiDAR-derived Digital Terrain Model (DTM) Generated over Vegetated Area in Tropical Region

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Abstract: Light Detection and Ranging (LiDAR) has been used intensively in various applications in tropical rainforest especially those related to digital terrain modeling including forestry, hydrology, ecology and management. Generating good quality of DTM over tropical rainforest region is very challenging. The discrepancy between ground collected terrain (reference data) and the LiDAR derived DTM increases in areas covered by dense vegetation. Previous studies have found that the accuracy of DTM is strongly related to landcover types, ground filtering process and interpolation methods. This paper presents investigations on the combination effect of landcover types, ground filtering approach and interpolation methods on Digital Terrain Model (DTM) generated from of airborne LiDAR over vegetated area in tropical environment. The airborne LiDAR data were collected on 26th June 2008 using Optech ALTM 3070 system mounted on a British Nomad aircraft. The average point sampling density is 0.75 point per m^2. The study area is separated into three landcover types i.e. oil palm, mangrove and mixed forest. The LiDAR data is filtered based on four methods i.e. 1) Adaptive TIN (ATIN), 2) Progressive morphology (Morph), and 3) Elevation Threshold with Expand Window (ETEW). The DTMs are generated by interpolating the ground points using Ordinary Kriging (OK) and Inverse Distance Weighted (IDW) methods. The quality of DTMs is evaluated based on the combination of quantitative and qualitative approaches. The reference data consist of 321 ground reference points collected over three study sites and each was collected using total station and optical-levelling techniques. The results show that combination of ATIN and Ordinary Kriging has produced DTMs with higher quality compared to other combination of filtering and interpolation technique. The smallest value of RMSE obtained for terrain covered by oil palm (0.21m) and followed by mixed forest (0.25m) and mangrove (0.32m). It is also noted that with a consistent parameter values, ATIN method has produced the best quality of DTM for all sites. Even though DTMs produced using IDW approach have smaller RMSE value, the DTMs produced by OK are able to closely represent the real terrain of the study area and contain less artificial bumps and pits.

Keyword: Digital terrain model, tropical, airborne LiDAR.