Vertical accuracy comparison of multi-source Digital Elevation Model (DEM) with Airborne Light Detection and Ranging (LiDAR)

ABSTRACT

Digital Elevation Model (DEM) is a digital representation of ground surface topography or terrain. There are many freely available DEM data with a spatial resolution of 30 m to 90 m. Nevertheless, their vertical accuracy may vary, depending on the vegetation cover and terrain characteristics. This study examined the vertical accuracy of open-access global DEMs (ALOS PALSAR, ASTER GDEM3, SRTM, TanDEM-X) and fused DEM (EarthEnvDEM90, MERIT DEM). Their performances were assessed using a Digital Terrain Model (DTM) generated using airborne LiDAR data that had an outstanding absolute vertical accuracy (mean error (ME) = 0.24 m; root mean square error (RMSEz) = 1.20 m). Height differences between the global DEMs and the LiDAR DTM were calculated and examined their performances by forested vs. non-forested, slope, and elevation classes. The results showed the MERIT DEM was superior to other DEMs in most of the testing methods. It outperformed other DEMs with an RMSEz value of 3.02 m in the forested areas, followed by ALOS PALSAR (9.29 m), EarthEnv-DEM90 (9.40 m), SRTM (9.80 m), TanDEM-X (10.41 m), and ASTER GDEM3 (12.57 m). The MERIT DEM also had the best accuracy in the higher elevation areas. Overall, the ASTER GDEM3 had the worst accuracies, with relatively large over-estimations compared to other DEMs. Despite its low spatial resolution, the MERIT DEM was the best for representing terrain elevation for applications over a large area.